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HWRIC REPORT AD95-025

Illinois Hazardous Waste Research and Information Center



Annual Report Fiscal Year 1994

(July 1, 1993 - June 30, 1994)



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ILLINOIS HAZARDOUS
WASTE RESEARCH AND
INFORMATION CENTER
ANNUAL REPORT FISCAL
YEAR 1994.

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INFORMATION CENTER
ANNUAL REPORT FISCAL
YEAR 1994.

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Champaign, IL 61820
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Hazardous Waste Research and Information Center

Annual Report Fiscal Year 1994

(July 1, 1993 - June 30, 1994)



Hazardous Waste Research and Information Center
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HWRIC's Mission

The Hazardous Waste Research and Information Center (HWRIC) was formed within the Illinois Department of Energy and Natural Resources (ENR) in 1984. HWRIC was charged with a mission to combine research and education; information collection, analysis and dissemination; and direct technical assistance to industry, agriculture, and communities. Working with industry to reduce waste at the source and to recycle those wastes that could not be reduced was also a priority. In September 1989 the signing of the Toxic Pollution Prevention Act (TPPA) formalized the Center's programs to include Research, Information Services, Industrial and Technical Assistance, Data Management and Laboratory Services. This Act (Public Act 86-914), which was amended in 1990 by Senate Bill 2253, expanded the Center's five programs to include a Pollution Prevention Program.



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Table of Contents

List of Tables	iii
List of Figures	iv
List of Abbreviations	v

Chapter I:	Introduction	1-1
-------------------	---------------------	------------

Chapter II:	Summary of Programs and Services
--------------------	---

A.	Introduction	2-1
B.	Pollution Prevention	2-1
C.	Research	2-3
D.	Laboratory Services	2-5
E.	Information Services	2-6
F.	Data Management	2-9
G.	References Cited	2-11

Chapter III:	Outreach and Assistance
---------------------	--------------------------------

A.	Introduction	3-1
B.	Assistance for Businesses	3-5
C.	Governor's Awards Program	3-19
D.	Citizens and Communities	3-23
E.	Educational Institutions	3-25

Chapter IV:	Collaborative Efforts
--------------------	------------------------------

A.	Introduction	4-1
B.	Chicago Area Projects	4-1
C.	Great Lakes Regional Projects	4-4
D.	Central Illinois Projects	4-5
E.	Southern Illinois / American Bottomlands Area Projects	4-5
F.	Summary	4-6

Chapter V:	Research and Development
-------------------	---------------------------------

A.	Introduction	5-1
B.	Center-Funded Projects	5-2
C.	Center-Conducted Projects	5-10
D.	Research Plan for FY'95	5-16

Chapter VI: Internal Resources Development

A.	Introduction	6-1
B.	Laboratory Capabilities Development	6-1
C.	Information Resources Development	6-3
D.	Special Waste De-listing System Development	6-5
E.	Additions to the Center's Hazardous Waste Database	6-5
F.	Automated Purchasing/Accounting Project	6-6
G.	Internal Support	6-7

Chapter VII: Sustainable Illinois

A.	Vision for the Future	7-1
B.	Overview of HWRIC's Role in Sustainable Development	7-2
C.	Building Foundations	7-5
D.	HWRIC and Illinois Business	7-11
E.	Sustaining Growth Through Anticipation	7-16
F.	References Cited	7-17

Appendix A: Fulltime Staff Publications and Presentations A-1

Appendix B: Governor's Pollution Prevention Awards Summaries B-1

Appendix C: Research Project Summaries C-1

List of Tables

Chapter I: Introduction

1-1.	HWRIC Fulltime Staff, End of FY'94	1-4
------	--	-----

Chapter II: Summary of Programs and Services

2-1.	HWRIC Research Project Solicitation Schedule	2-3
2-2.	HWRIC Laboratory Clients and Services	2-7
2-3.	Objectives of HWRIC's Data Management Section	2-9

Chapter III: Outreach and Assistance

3-1.	HWRIC Outreach and Assistance, FY'94	3-2
3-2.	FY'94 Site Visits by Manufacturing Type	3-5
3-3.	Seventh Annual Governor's Pollution Prevention Award Winners	3-20
3-4.	Seventh Annual Governor's Pollution Prevention Certificate Winners	3-20
3-5.	Eighth Annual Governor's Pollution Prevention Award Recommendations	3-22

Chapter IV: Collaborative Efforts

4-1.	FY'94 Collaborative Projects with Government Agencies	4-6
------	---	-----

Chapter V: Research and Development

5-1.	Completed Research Projects	5-2
5-2.	Continuing Research Projects	5-3
5-3.	FY'94 Published Reports and Documents	5-6
5-4.	Externally Funded Research Projects	5-11
5-5.	New Research Projects	5-17

Chapter VI: Internal Resources Development

6-1.	Library Collection Development FY'94	6-3
6-2.	Clearinghouse Collection Development FY'94	6-4
6-1.	HWRIC Library Services FY'94	6-5

Chapter VII: Sustainable Illinois

7-1.	Roles of Economic Sectors in Developing a Sustainable Economy	7-10
------	---	------

List of Figures

Chapter I: Introduction

- 1-1. HWRIC's Director, Dr. David L. Thomas 1-1
- 1-2. HWRIC Organizational Structure 1-1

Chapter II: Summary of Programs and Services

- 2-1. Great Lakes Information Resources Projects 2-8
- 2-2. Map Output from HWRIC Historical Hazards Database 2-10

Chapter III: Outreach and Assistance

- 3-1. Key 1994 Publications 3-4
- 3-2. Lab Analysis of Oil and Grease 3-10
- 3-3. Wagons on the Line at Radio Flyer 3-12
- 3-4. Radio Flyer Pre-Cleaning Bath Line 3-12
- 3-5. Oil and Grease Levels in Radio Flyer Wash Tank 3-13
- 3-6. Burlington Northern's Ultrafiltration Unit 3-14
- 3-7. Alternative Solvents Testing Unit 3-15
- 3-8. Governor's Awards Winners, 1987-1993 3-19
- 3-9. Central States Receiving Governor's Pollution Prevention Certificate 3-21
- 3-10. FY'93 State Fair Display 3-24

Chapter IV: Collaborative Efforts

- 4-1. Opening Ceremonies for the Chicago Manufacturing Center 4-3

Chapter V: Research and Development

- 5-1. Removing a Leaking Underground Storage Tank 5-5
- 5-2. Pollution Prevention Information Resources Survey Results 5-12
- 5-3. Lab Microtox Testing of Aircraft Washwater 5-16

Chapter VI: Internal Resource Development

None

Chapter VII: Sustainable Illinois

None

List of Abbreviations

ACF	= Activated Carbon Filters
ACS	= American Chemical Society
AEEI	= Andrews Environmental Engineering, Inc.
ALAD	= Aminolevulinic Acid Dehydratase
ANL	= Argonne National Laboratory
ARC	= Advanced Recycling Centers
ASTM	= American Society for Testing and Materials
ATSDR	= Agency for Toxic Substances and Disease Registry
BDAT	= Best Demonstrated Available Technology
BLC	= Blood Level Concentration
BNRC	= Board of Natural Resources and Conservation
BTEX	= Benzene, Toluene, Ethylbenzene, and Xylene
CAAA	= Clean Air Act Amendments
CDB	= Capital Development Board
CEC	= Cation Exchange Capacity
Center	= Hazardous Waste Research and Information Center
CERCLA	= Comprehensive Environmental Response, Compensation, and Liability Act
CERL	= U.S. Army Corps of Engineers Construction Engineering Research Laboratory
CFCs	= Chlorofluorocarbons
CICI	= Chemical Industry Council of Illinois
CMC	= Chicago Manufacturing Center
COD	= Chemical Oxygen Demand
COMPETE	= Coalition for Manufacturing Performance Through Technology
CONWR	= Crab Orchard National Wildlife Refuge
CPC	= Chicagoland Processing Corporation
CRC	= Community Recycling Center
CSD	= Consultants and Services Database
CTAP	= Critical Trends Assessment Project
DCCA	= Illinois Department of Commerce and Community Affairs
District	= Metropolitan Water Reclamation District of Greater Chicago
DMS	= Data Management Section AND Danville Metal Stamping
DOH	= Degree of Hazard
DPH	= Illinois Department of Public Health
EBS	= Electronic Blue Sheet
EEN	= Environmental Extension Network
ENR	= Illinois Department of Energy and Natural Resources
FDA	= Food and Drug Administration
FEMA	= Federal Emergency Management Agency
FS	= Farm Supply
GC	= Gas Chromatography
GIS	= Geographic Information System
GRF	= General Revenue Fund
GSAC	= Governor's Science Advisory Committee
HDPE	= High Density Polyethylene
HML	= Hazardous Materials Laboratory
HPLC	= High Performance Liquid Chromatography
HWRIC	= Hazardous Waste Research and Information Center

ICP/MS	= Inductively Coupled Plasma/Mass Spectrometer or Spectrometry
IDOT	= Illinois Department of Transportation
IEPA	= Illinois Environmental Protection Agency
IES	= Institute for Environmental Studies
IGIS	= Illinois Geographic Information System
IIT	= Illinois Institute of Technology
IMA	= Illinois Manufacturers' Association
ISP	= Information Services Program
ISU	= Illinois State University
LAN	= Computer Local Area Network
LSP	= Laboratory Services Program
LUSTs	= Leaking Underground Storage Tanks
MBA	= Master's of Business Administration
MCLs	= Maximum Contaminant Levels
MSDS	= Material Safety Data Sheets
MWRDGC	= Metropolitan Water Reclamation District of Greater Chicago
NIF	= Nature of Illinois Foundation
NIST	= National Institute of Standards and Technology
OMC	= Outboard Marine Corporation
OTS	= Obligation Tracking System
P2	= Pollution Prevention
PA	= Public Act
PAP	= Program Advisory Panel
PC	= Personal Computer
PCBs	= Polychlorinated Biphenyls
PCE	= Perchloroethylene
PIP	= Partners in Prevention
PPIS	= Pollution Prevention Incentives to States
PPM	= Parts per Million
PPS	= Phosphate/Paint System
RCRA	= Resource Conservation and Recovery Act
RF	= Radio Flyer
RR	= Research Report
RRT	= Reduction and Recycling Techniques/Technologies
SARA	= Superfund Amendments and Reauthorization Act
SCRAP	= School Recycling Assistance Program
SDWA	= Safe Drinking Water Act
SETAC	= Society of Environmental Toxicology and Chemistry
SGS	= Illinois State Geological Survey
SIC	= Standard Industrial Classification
SIUs	= Significant Industrial Users
SVE	= Soil Vapor Extraction
SWMF	= Solid Waste Management Fund
SWS	= Illinois State Water Survey
TCLP	= Toxicity Characteristic Leaching Procedure
THM	= Toxic Heavy Metals
TN	= Technical report
TPPA	= Toxic Pollution Prevention Act
TR	= Technical research report
TRI	= Toxic Release Inventory
TQM	= Total Quality Management
USEPA	= United States Environmental Protection Agency

- UIUC = University of Illinois at Urbana-Champaign
- USDW = Underground Sources of Drinking Water
- VIA = Valley Industrial Association
- VRT = Variable Rate Technology
- WES = U.S. Army Corps of Engineers Waterways Experiment Station

Chapter I: Introduction

The Hazardous Waste Research and Information Center (HWRIC) was formed within the Illinois Department of Energy and Natural Resources (ENR) in 1984. HWRIC became a division within ENR in 1990, and is affiliated with the University of Illinois, Urbana-Champaign (UIUC). HWRIC's building, the Hazardous Materials Laboratory (HML), is owned and operated by UIUC. The Center was charged with a mission to combine research and education; information collection, analysis, and dissemination; and direct technical assistance to industry, agriculture, and communities. Working with industry to reduce waste at the source, and to recycle those wastes that could not be reduced, was an early priority of the Center.



FIGURE 1-1: HWRIC DIRECTOR
DAVID L. THOMAS, PH.D.

The Center's focus on waste reduction was formalized in September 1989 by the *Illinois Toxic Pollution Prevention Act* (TPPA). This Act (Public Act 86-914), which was amended in 1990 by Senate Bill 2253, expanded the Center's five programs (Research, Information Services, Industrial and Technical Assistance, Data Management, and Laboratory Services) to include a Pollution Prevention Program. HWRIC's current organizational structure is illustrated in Figure 1-2. Table 1-1 at the end of this chapter lists FY'94 HWRIC staff.

The state-funded headcount for HWRIC during FY'94 was 26 on General Revenue Funds (GRF), 4.5 on Solid Waste Management Funds (SWMF), and 2 on other state funds. (Some of these positions were not fully funded and thus were not filled.) Total staff at HWRIC, including contract and part-time personnel, is 48. The state budget for the Center is about \$2.1 million, with about \$760,000 of this designated for sponsored research projects.

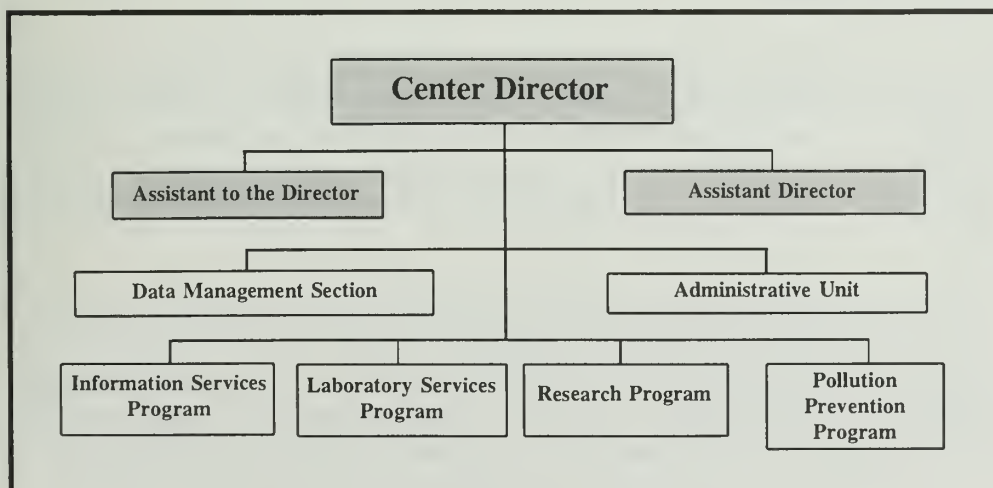


FIGURE 1-2: HWRIC FY'94 ORGANIZATIONAL CHART

The Center answers to the Board of Natural Resources and Conservation (BNRC), which consists of scientific and technical experts in the areas of expertise of the Center and three scientific surveys. It is chaired by the Director of ENR. The Board was formed by legislation (Public Act 80-1218) to approve personnel actions of the Scientific Surveys and HWRIC, and to provide programmatic oversight. The Center also has a Program Advisory Panel (PAP), the primary purpose of which is to provide an external source of advice on the Center's programs. The panel includes representatives from industry, other state agencies, universities, and environmental groups.

This report covers the period July, 1993 through June, 1994 (the Fiscal Year 1994). It is organized by types of activities and outreach provided by the Center. Our attempt is to describe the integrated nature of all of HWRIC's programs to help meet our mandate of finding solutions to Illinois' hazardous waste problems. However, organizing the report in this way does create some redundancies in summaries of specific program activities between sections.

The Center's Sustainable Illinois Initiative recognizes that environmental protection and enhancement, so important for both our physical and spiritual well being, needs to be balanced with our state's needs for jobs, a strong economy, and productive industry.

Chapter II of the report presents a brief summary of each of the Center's programs and services offered. Chapter III summarizes the Center's outreach efforts to various groups within Illinois. The focus of much of HWRIC's outreach continues to be the promotion of pollution prevention and the provision of information and technical assistance. A specific priority this year was to expand our efforts to reach businesses in the more populous northeastern part of the state. Some of these activities are described in Chapter IV. Chapter V describes the Center's research efforts, both sponsored research and projects undertaken by HWRIC staff. Chapter VI describes some of the tools developed within the Center to help staff better serve their customers.

Chapter VII discusses projected future HWRIC activities and priorities that will bring us as a state closer to the goal of a sustainable future. We have called our initiative for the future "Sustainable Illinois." Our initiative recognizes that environmental protection and enhancement, so important for both our physical and spiritual well being, needs to be balanced with our state's needs for jobs, a strong economy, and productive industry.

We believe that as a society we need to look at "sustainable development," that is, meeting our current societal needs without compromising the ability of future generations to satisfy their own needs. While many others in the state will play a significant role in this regard, the Center's pollution prevention, education, research and outreach activities are all important components to help assure a sustainable future.

Of particular importance during FY'94 was the initiation of efforts to establish a presence in the Chicago area. In January of 1994 we hired an engineer for our Pollution Prevention program to work out of the offices of the Water Reclamation District of Greater Chicago. This is a contract position to provide pollution prevention information and assistance to industrial users of the sanitary district.

We also negotiated a contract with the Chicago Manufacturing Center (CMC) to co-locate a small staff in their offices. HWRIC staff will integrate pollution prevention assistance with the CMC's activities to help businesses modernize and become more efficient and competitive. Legislative action at the end of the session allocated \$200,000 to HWRIC for the Chicago area office. These funds, added to the CMC's contract funds, will allow us to better serve businesses in northeastern Illinois.

Throughout this report we have attempted to express the integrated nature of our work. It is obvious to us that the modern, complex environmental problems we face require the cooperation and coordination of specialists from many disciplines. We are attempting to provide this integrated approach both within our Center, and by teaming with others outside the Center. This report follows last year's annual report in its emphasis on describing the nature and extent of these collaborative efforts.

TABLE 1-1: HWRIC FULL TIME STAFF BY PROGRAM, END OF FY'94*

***(NOTE THAT FUNDING SOURCES VARY)**

Administration

David Thomas, Director
Gary Miller, Assistant Director
John Marlin, Assistant to the Director/Data Management Manager
Katherine Day, Human Resources and Administrative Services Manager
Christine Murphy-Lucas, Business and Finance Manager
Daniel Kraybill, Waste Management Assistance Specialist
June Wilhite, Laboratory Purchasing Agent
Karen Miller, Human Resources/Office Assistant
Betty Stites, Office Assistant
John Marlin, Data Management Manager
Martin Bailey, Database Management Specialist
Lisa Damon, Database Management Assistant
Deborah Gaines, Computer Systems Specialist
Steven Murray, Database Management Assistant

Laboratory Services Program

Marvin Piwoni, Laboratory Services Manager
Teresa Chow, Senior Analytical Chemist
Jack Cochran, Senior Organic/Analytical Chemist
Scott Dalbey, Facilities and Safety Coordinator
Bradley Daniels, Screening Laboratory Chemist
Gina Eversole, Organic Preparations Chemist
Peter Gintautus, Research Associate
David Green, Gas Chromatographer
Amy Hughes, Inorganic Preparations Chemist
Daniel McGinness, Quality Assurance Officer
Aaron Weiss, Senior Inorganic/Analytical Chemist

Pollution Prevention Program

Timothy Lindsey, Pollution Prevention Program Manager
Kenneth Barnes, Pollution Prevention Technical Assistant
Christine Hayes, Pollution Prevention Technical Assistant
Debra Morrow, Process Evaluation Technical Assistant
Joe Pickowitz, Pollution Prevention Technical Assistant
Beth Simpson, Pollution Prevention Technical Assistant

Research Program

Jacqueline Peden, Research Program Manager
Laurie Case, Research Project Officer
Pamela Tazik, Research Project Officer
Angela Simon, Research Program Assistant

Information Services Program

Sara Tompson, Information Services Program Manager/Librarian
Carla Blue, Information Assistant

Chapter II: Summary of Programs and Services

A. Introduction

This Chapter provides a brief overview of some of the Center's programs, services and priorities. Additional information can be found in past annual reports published by the Center ((1), (2)). Specific projects addressed by the Center and collaborative efforts undertaken with others are addressed elsewhere in this report.

B. Pollution Prevention

In 1986, HWRIC's Pollution Prevention Program was established as a longterm approach to solving Illinois' waste management problems. HWRIC's program relies on direct technical assistance to industry, education programs, and research support to promote waste reduction and improve waste management. The *Illinois Toxic Pollution Prevention Act* (TPPA, Public Act 86-915), passed in 1989, formalized HWRIC's Pollution Prevention (P2) Program and delineated specific responsibilities. These responsibilities include the following:

- Provide information on and publicize the advantages of source reduction
- Establish courses, seminars, workshops, and other training aids
- Publish exemplary accomplishments
- Research pollution prevention methods and transfer established technologies
- Provide on-site technical assistance to identify opportunities and develop plans for on-site remediation wherever possible
- Sponsor pilot projects to develop and demonstrate innovative technologies
- Establish and operate a clearinghouse, and
- Use engineering field internships to identify P2 opportunities.

An effective pollution prevention program reduces waste releases to all media — air, water and land. HWRIC's program encourages companies to closely examine how materials flow through their facilities, to pinpoint where and why wastes are generated, and to identify technologies, equipment, and/or new operating practices that reduce these wastes. Pollution prevention is a win-win program, wherein businesses cut costs and increase efficiency and competitiveness while concurrently protecting the environment.

The specific activities of HWRIC's P2 program are to:

- Provide technical assistance to industry
- Develop and demonstrate clean technologies
- Recognize exemplary pollution prevention accomplishments through the annual

Pollution prevention is a win-win program, wherein businesses cut costs and increase efficiency and competitiveness while concurrently protecting the environment.

Governor's Pollution Prevention Awards

- Educate, train and transfer technology
- Answer regulatory questions as they relate to source reduction legislation and assist with permits, and
- Provide assistance with economic justification of implementation strategies.

No state appropriations have been provided under the Illinois TPPA to carry out HWRIC's designated responsibilities. The Center's Pollution Prevention Program utilizes approximately \$500,000 of HWRIC's annual state General Revenue Fund (GRF) appropriation. In addition, some federal funds were obtained in FY'94 (as in previous years) to supplement this support.

The most visible aspect of HWRIC's Pollution Prevention Program is technical assistance. P2 staff provide information and services on solving environmental problems to Illinois citizens, businesses, educational institutions, communities, and governmental units. Source reduction, recycling, and other methods of waste reduction are emphasized. Other services include: guidance on regulatory and permitting matters; recommendations on appropriate waste handling methods; and, referrals to qualified service organizations.

Because HWRIC is a nonregulatory organization, the assistance provided is advisory only; companies and individuals are not required to follow the recommendations and advice given by Center staff. HWRIC does not report site-specific findings to state regulatory agencies.

HWRIC funds clean technology development and demonstration projects by providing up to \$50,000 per year in matching funds to industry for applied research.

HWRIC also funds clean technology development and demonstration projects under its Reduction and Recycling Techniques/Technologies (RRT) Program. The RRT Program promotes pollution prevention in Illinois by providing up to \$50,000 per year for applied research. Awards can be obtained for development or demonstration of waste reduction techniques and technologies, or for testing new applications of existing methods. An RRT award must be equally matched by the contractor with either funding from other sources or in-kind services. Projects generally focus on: modifying industrial processes to eliminate, reduce, or replace toxic materials; or, testing the process capabilities of equipment for reducing, detoxifying, or recycling wastestreams.

Under the RRT program, Center staff provide technical support to Illinois businesses and industries to conceive and implement workable projects. HWRIC engineers and scientists are available, upon request, to provide "hands on" assistance with project development, initiation, and management. In FY'94, HWRIC used its well equipped Pilot Laboratory to solve wastestream separation problems for a number of industries by using ultrafiltration, reverse osmosis, vacuum evaporation and centrifugation for a number of industries. In addition, HWRIC has become a recognized test facility for the demonstration of safe cleaning techniques, employing aqueous cleaners where hazardous organic solvents were previously used.

C. Research

Each year, HWRIC receives an appropriation from the state to support research to:

- Investigate the problems associated with historical and existing waste management practices
- Explore solutions to those problems, and
- Develop ways to prevent those problems from occurring in the future.

The distribution of these funds and the monitoring of how they are used are the responsibility of the Center's Research Program. For FY'94, the money appropriated to fund research was \$702,400 (\$662,400 from General Revenue and Hazardous Waste Research Funds, and \$40,000 from Solid Waste Management Funds). These funds are primarily available to investigators working in Illinois, although researchers from other states have received limited support for projects of significance to Illinois.

HWRIC funded 26 projects during FY'94. Fifteen of those projects will continue during FY'95.

Each year, HWRIC's Research Program staff and management identify topics of particular interest to the state and solicit preproposals in those areas during December and January. The preproposals that are received are evaluated by Center staff. Full proposals are requested from those researchers whose ideas address important waste management problems and/or offer significant scientific contributions towards our knowledge of waste management issues. Full proposals are evaluated both by Center staff and external peer reviewers. Those projects that respond to the most urgent problems and seem most likely to succeed or to have an immediate benefit to the state are selected for funding. Projects generally begin October 1. The project selection schedule is presented in Table 2-1.

TABLE 2-1: ANNUAL PROJECT SOLICITATION SCHEDULE

HWRIC RESEARCH PROJECT SOLICITATION SCHEDULE	
Preproposal Solicitation	December
Preproposals Due	January 31
Preproposal Review (HWRIC)	February - March
Request for Proposals	April
Proposals Due	May 15
Proposal Review (HWRIC and External Reviewers)	May 15 - July 15
Project Selection	July 15 - August 15
Projects Begin	October

HWRIC's second solicitation, for Reduction and Recycling Techniques/Technologies (RRT), is directed toward industry and focuses on technology development and evaluation. The RRT request for proposals is announced each February, preproposals are reviewed internally, and projects are selected for funding beginning October 1. HWRIC requires a 100% match by the industry participants for the projects selected through this solicitation. Many of these projects make use of the Center's services and equipment, and the expertise of Center staff. Some involve in-plant assistance and testing as well as investigations in HWRIC's Pilot Laboratory facility. The outcome of these endeavors are usually a reduction in waste through new technologies or new uses for existing technologies with potential widespread industrial application.

The Research and RRT projects selected for funding during FY'94 are discussed in Chapter 5 of this report. While some projects investigate the extent of existing contamination problems, most are examinations of methods for treating the problem, or techniques and technologies to prevent future problems. HWRIC Research Program staff work with the investigators during the course of their projects, providing comments on the work as it progresses, serving as sources of information when needed, and often assisting with industrial process evaluations. Research Program staff have worked to supplement the funding allocated to the program by co-funding projects with other agencies and obtaining external funding to pursue additional topics of interest to the Center. These efforts will continue in FY'95, as described in Chapter 5.

The results of Center-funded research, as well as Center-conducted research, are made available in a variety of ways. Most research projects end in peer-reviewed reports published by HWRIC and made available through our Clearinghouse.

By managing the projects that the Center supports and also conducting internal investigations, HWRIC's staff have become very familiar with a variety of industries, the wastes they produce, and technologies or techniques that can reduce those wastes. Research Program staff learn, over the course of projects, about contamination problems in the state, how these sites can be cleaned up, how the problems can be avoided, and how both the contaminants and their removal can effect human health.

Staff must maintain an awareness of what types of hazardous waste research efforts are being supported on a national level to avoid duplications in the Center's research program and to identify and take advantage of joint funding opportunities. Associations with individuals from other agencies/organizations that fund research are sought. Through these contacts, expert reviewers are found for proposals and final reports. These experts are an added source of technical information and are essential to our selection of quality projects. Information from the research we fund and conduct is combined with what is learned from our reading, technical meeting participation, and personal/professional associations to respond to inquiries from the public, legislators, industries, and others. It serves as a basis for technical papers and presentations and sometimes policy recommendations.

The results of Center-funded research, as well as Center-conducted research, are made available in a variety of ways. Articles in peer-reviewed and technical publications are encouraged, as are presentations at meetings, seminars and workshops. Factsheets and brochures describing research projects and/or their results are prepared and distributed to technical organizations and companies that might benefit from the information they contain.

Most research projects end in peer-reviewed research reports published by HWRIC and made available through our Clearinghouse.

D. Laboratory Services

The Laboratory Services Program (LSP) was developed to provide analytical and logistical support to researchers working with hazardous waste. Program analytical resources are particularly well suited to exploring the chemical problems associated with industrial development of waste reduction, recycling, and reuse strategies. The physical layout of the Hazardous Materials Laboratory (HML) is presented in HWRIC's FY'93 annual report (1).

The LSP offers support to pollution prevention, remediation, and waste treatment research projects in the form of chemical characterization of process and waste streams, both before and after application of engineering technologies to these streams. This information can then be used to make decisions on technologies and other strategies for treating and reducing waste and increasing process efficiency.

Program support on industrial projects often takes the form of information on the chemical composition of industrial process and waste streams and air emissions. Laboratory instrumentation permits identification and measurement of most organic and inorganic components likely to be present in such process and waste streams.

In the past year, industrial projects have included analysis for volatile organics in diesel exhaust and in a factory process line work environment, heavy metals in cooling waters, oil and surfactants in a variety of aqueous cleaning solutions, and waxes in edible oils. The analytical experience gained from working with such complicated industrial matrices is being applied by the program's chemists to the analysis of process and waste streams from a wide variety of industries. HWRIC's specific analytical capabilities are summarized in the FY'93 annual report (1).

Because of the complications of analyzing for different components in extremely diverse samples, LSP staff approach the analytical characterization of most process or waste streams as methods development problems. The required analyses often do not include regulated pollutants for which U.S. Environmental Protection Agency (USEPA) methods have been defined. Even when such analytes are targeted, some adjustments to the methodology are often required to address specific recycling/reuse questions or to compensate for the complexity of the waste matrix.

Program staff have been active in methods development for some common industrial contaminants. Staff chemists have helped vendors develop and evaluate new products for application to oil and grease measurements in wastestreams, particularly in the presence of surfactants and other cleaning additives. These new products have been evaluated in our facility on real samples from projects involving industrial conversion from vapor degreasing to aqueous-based cleaning.

Lab projects for industry have included analysis for: volatile organics in diesel exhaust and in a factory process line work environment; heavy metals in cooling waters; oil and surfactants in aqueous cleaning solutions; and waxes in edible oils.

Refinements to the Center's metals analysis instrumentation are improving measurement of heavy metals at very low levels in rainwater and in industrial cooling waters.

Similarly, HWRIC staff have been active in evaluating new methodologies and new applications of instrumentation for the analysis of contaminants. Enhanced mass spectrometric capabilities being evaluated on one of our instruments will allow the lab to refine its measurement capabilities for widespread organic contaminants such as polychlorinated biphenyls (PCBs). Similarly, refinements to our metals analysis instrumentation are improving measurement of heavy metals at very low levels in rainwater and in industrial cooling waters.

LSP analytical services are available to a variety of potential users (see Table 2-2). Primary clients are the industries that come to HWRIC for assistance with pollution prevention. Most of the work done for such clients is through the Pollution Prevention (P2) Program staff's assistance efforts, but the lab has, on occasion, worked directly with industry to solve analytical chemistry-based problems. The LSP also supports a variety of researchers, both public and private, working in the general area of hazardous waste problems. Researchers include those receiving HWRIC research funding, and researchers at the scientific surveys, the University of Illinois, The U.S. Army Corps of Engineers Construction Engineering Research Laboratory (CERL) or elsewhere who have research funding from other sources. This support generally takes the form of chemical analyses that the researchers are not able to perform themselves. In some cases, the lab staff also helps conduct the research.

The Center also provides space in the HML for use by researchers from outside of HWRIC. The Pilot Laboratory represents the most striking example of this. This facility is used by a variety of industrial clients to investigate the suitability of particular treatment technologies to address their waste problems. Use of this laboratory is arranged through HWRIC P2 staff. Additional laboratory space is available for the conduct of bench and intermediate scale experimentation. Most of this space is located within the HML's high hazard area, and is fitted with special air handling, waste handling and other design considerations specific to the handling of more toxic materials. LSP staff provide coordination of laboratory use and often contribute technical guidance and analytical support to such projects.

E. Information Services

Fulfilling HWRIC's legislative mandate to compile, analyze, and disseminate hazardous waste-related information is the principal responsibility of the Information Services Program (ISP). The ISP includes two full time staff — the Manager/Librarian and the Outreach Specialist — and several part-time and student staff. Program staff are responsible for connecting internal (HWRIC) and external clients with information and materials.

The program manages the Library and Clearinghouse resources and the online databases for both. ISP staff also produce factsheets and mandated and technical reports, organize workshops, and coordinate or participate in other outreach and education efforts.

TABLE 2-2: HWRIC LABORATORY SERVICES

HWRIC Laboratory Clients and Services	
<u>Prospective Clients</u>	<u>Support Provided</u>
HWRIC-Funded Researchers	<p>Laboratory space on approval basis.</p> <p>Project guidance on analytical issues -- methods development; sample screening; analysis of samples for primary quantitation and for quality assurance purposes.</p>
Industrial Clients	<p>Pilot Lab or Research Lab access for special testing generally coordinated through P2 staff.</p> <p>Analytical methods development, sample screening, and quantitative analysis on waste and process streams. Before and after analyses for testing/treatment experiments. Specialty testing to support industrial in-house research efforts.</p>
External Researchers (not HWRIC-funded; including public and private sector scientists)	<p>Laboratory space on approval basis.</p> <p>Analytical methods development, quality assurance support, and sample analysis as requested.</p>
Graduate Research Students	<p>Guidance on sampling and analysis.</p> <p>Full range of analytical services in support of research or class projects.</p>
Federal Agencies	<p>Literature review, pursuit of research issues, methods development, and analyses. Support generally includes space within the HML to conduct the research project.</p> <p>Analysis and methods development performed on samples generated by HWRIC research staff, or by agency staff or outside researchers. Analytical services including confirmation, quantitation and quality assurance functions.</p>

HWRIC's core information resources are contained in the Library and Clearinghouse. The HWRIC Library contains close to 8,000 items, including books, government reports, journals, maps, video and audio tapes, and articles. Records for the Library collection are maintained in three separate INMAGIC databases — library (books and audio/visual materials), magazines, and article citations. All staff can access the databases directly from their office PCs via our Local Area Network (LAN). The Library collection does not circulate directly outside the Center, but interlibrary loan requests are honored.

Clearinghouse reports are available to any clients — businesses, citizens, schools, etc. — located in Illinois or elsewhere. HWRIC charges a nominal fee for some reports to recover some of the reproduction costs.

The Clearinghouse includes two collections of materials. The first is the collection of HWRIC-produced reports including over 100 items. Most of these are final reports on research projects sponsored by the Center. Also included are pollution prevention factsheets as well as technical and administrative reports. The second Clearinghouse collection of over 200 items includes brochures, pamphlets, and other brief publications produced by HWRIC, the U.S. and Illinois Environmental Protection Agencies (USEPA, IEPA) and other agencies, arranged in 23 topical areas. The Clearinghouse database is also in INMAGIC format, and is used for inventory as well as holdings purposes. Clearinghouse reports are available to any clients — businesses, citizens, schools, etc. — located in Illinois or elsewhere. HWRIC charges a nominal fee for reports to recover some of the reproduction costs.

HWRIC's Information Services Program is increasingly involved in regional and national efforts to network pollution prevention assistance providers and/or clearinghouses. This fiscal year, ISP staff conducted a project, funded by the Great Lakes Protection Fund, to survey pollution prevention information providers in the Great Lakes Region, then make recommendations for cooperative and collaborative strategies to better deliver information to industry clients. Two reports produced as part of this project are available at no charge from our Clearinghouse (Figure 2-1).

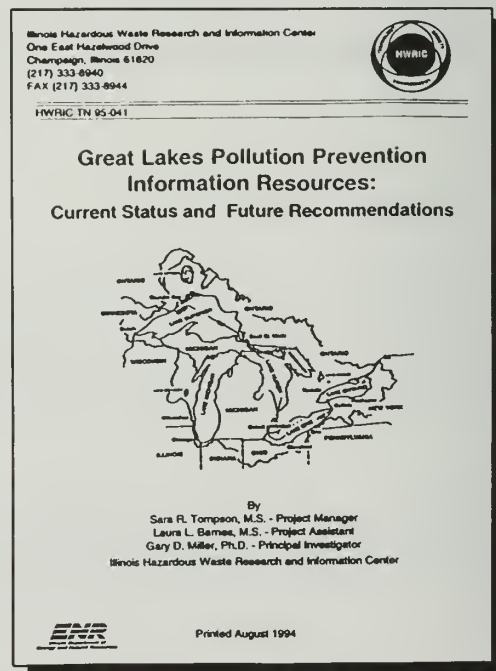
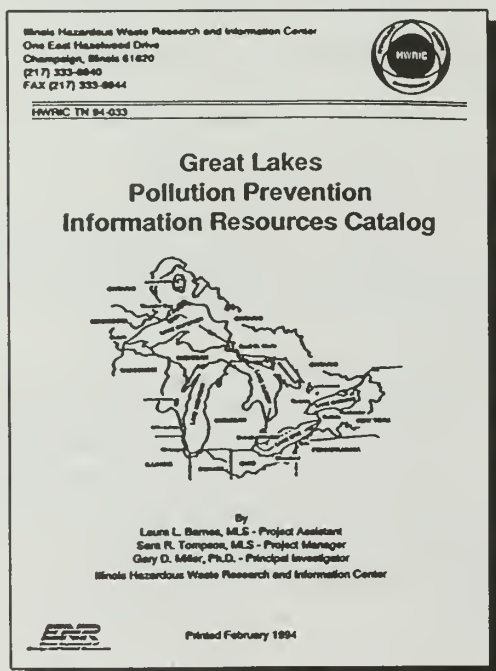


FIGURE 2-1: GREAT LAKES INFORMATION RESOURCES REPORTS

F. Data Management

The Data Management Section (DMS) serves the research, information and outreach goals of the Center by maintaining a hazardous waste database for Illinois, responding to requests for information from this database, and managing HWRIC's computer resources. Data Management staff utilize the Center's Geographic Information System (GIS) and access many state-wide geographic data resources through the IGIS (Illinois Geographic Information System) within our main agency, the Illinois Department of Energy and Natural Resources (ENR).

HWRIC's hazardous waste database is comprised of information from many different sources, including USEPA, IEPA and research conducted or sponsored by the Center. Much of these data, such as the Toxic Release Inventory (TRI) and Annual Hazardous Waste Reports, exist as a result of federal or state mandates that require reporting for the purpose of monitoring and regulating industrial waste activities. Some data, such as the Historical Hazards GIS database, provide a glimpse of prior industrial hazardous waste activities. The Center's hazardous waste database currently contains many types of hazardous waste-related files, ranging from TRI data to state business patterns data (see Chapter 6 for more details). The Center's GIS capabilities are an integral part of the database and allow hazardous waste data to be analyzed spatially. New information is added to HWRIC's database every year.

One of the most visible uses of the database is to identify hazardous waste sites at or near properties that are being sold. DMS staff prepare reports and maps to assist individuals conducting preliminary site assessments. Figure 2-2 on the following page is representative of maps produced by Data Management from the Historical Hazards GIS database.

In addition to property transfer searches, the database has been used to define and characterize various hazardous waste activities for the purpose of developing policies for the management of these wastes. HWRIC researchers developed the "Degree-of-Hazard" characterization scheme that can be used to declassify special wastes not regulated under the federal Resource Conservation and Recovery Act (RCRA). The database is also used internally to support Center activities such as those of the Pollution Prevention Program.

The role Data Management plays in managing HWRIC's computer resources has become increasingly important as technology advances. DMS administers HWRIC's LAN and Sun/Unix Environment. Program staff also provide support for the Center's computing resources including software and hardware evaluation, applications programming, and staff training.

HWRIC's hazardous waste database is comprised of information from many different sources, including USEPA, IEPA and research conducted or sponsored by the Center. Much of these data exist as a result of federal or state mandates that require reporting for the purpose of monitoring and regulating industrial waste generation and disposal activities.

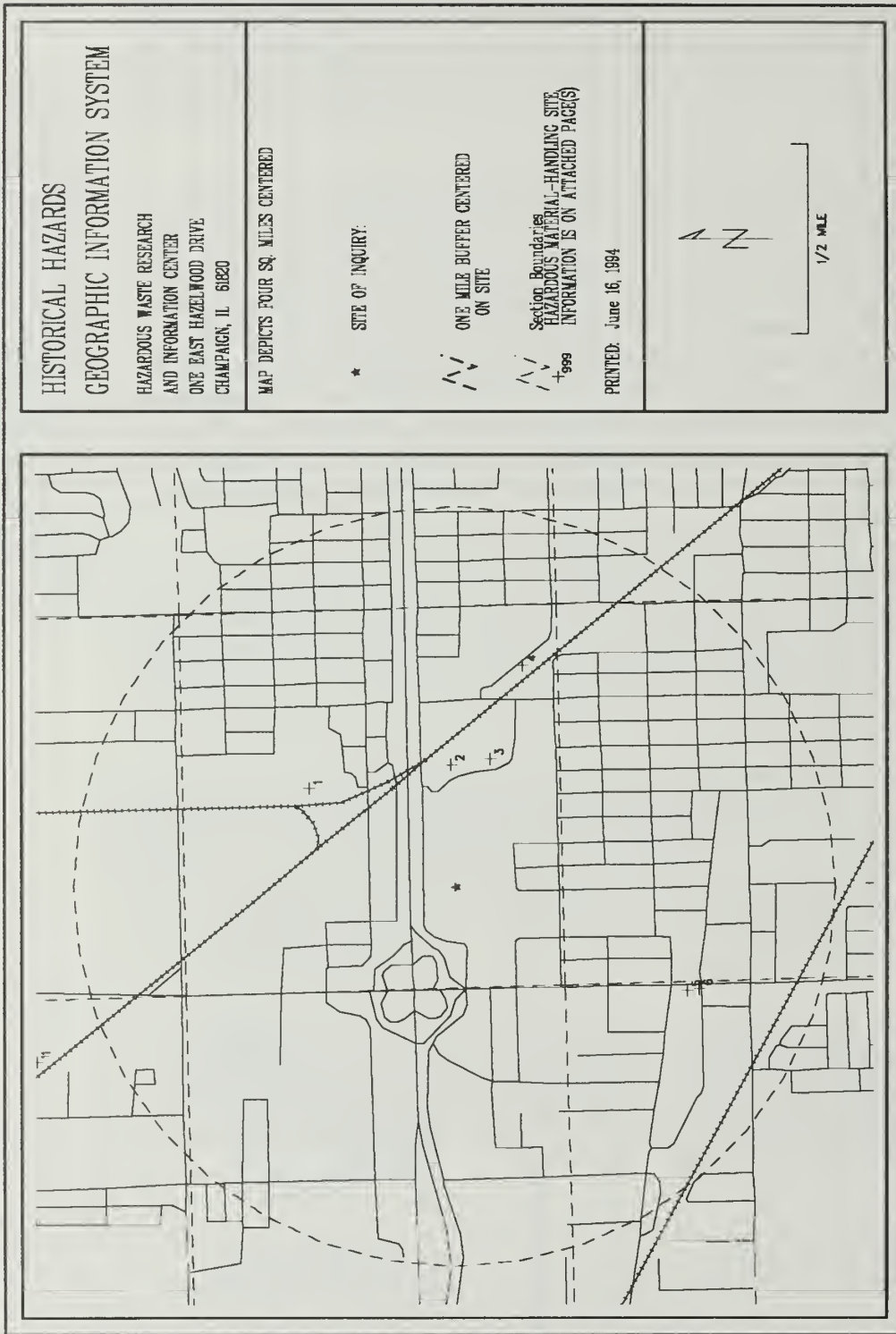


FIGURE 2-2: HWRIC HISTORICAL HAZARDS GIS REPORTS CAN INCLUDE A MAP LIKE THIS, PINPOINTING SITES OF PAST INDUSTRIAL CONTAMINATION

G. References Cited

- (1) *Illinois Hazardous Waste Research and Information Center Annual Report, Fiscal Year 1993*. Champaign, IL: HWRIC, 1993. (HWRIC Report AD93-023)
- (2) *Illinois Hazardous Waste Research and Information Center Annual Report, Fiscal Year 1992*. Champaign, IL: HWRIC, 1992. (HWRIC Report AD91-019)

Chapter III: Outreach and Assistance

A. Introduction

During our tenth anniversary year, technical assistance to both the private and public sectors remained the cornerstone of the Center's programs. Staff members answered the whole gamut of questions posed by private citizens from "How do I dispose of my household hazardous wastes?" to "Should I be concerned about exposure to pesticides after my landlord sprayed my apartment?" For businesses and organizations, a more complicated matrix of services usually needs to be provided to respond to their questions. These requests range from how to incorporate pollution prevention (P2) into the mainstream of an operation, to assistance with a myriad of compliance issues, to requests for published literature documenting source reduction and remediation success stories, to identification and laboratory demonstration of the best control technologies for specific waste reduction needs.

Since 1989, when the *Illinois Toxic Pollution Prevention Act* mandated the Center's pollution prevention services and resources, we have expanded our technical assistance efforts, compiling an impressive list of success stories that allow staff to more effectively promote the unique services that we offer. Since 1989, pollution prevention has come to be more commonly recognized as good business and has also become a key component of new state and federal environmental initiatives and regulations. This shift in the regulatory context bodes well for major advancements in the competitiveness of U.S. industry, and has fostered mutual cooperation between industry and government.

Since 1989, when the *Illinois Toxic Pollution Prevention Act* mandated the Center's pollution prevention services and resources, we have expanded our technical assistance efforts, compiling an impressive list of success stories that allow staff to more effectively promote HWRIC's unique services.

Part of the responsibility of HWRIC staff is to underscore the added value of P2 programs in the following key business areas:

- **Financial Savings** — there is an unrecoverable price to be paid for escalating waste management and compliance costs, and for the loss of raw materials and products by emissions or off-site disposal.
- **Positive Public Image** —The *Community Right-to-Know Act* (SARA Title III) forced many industries to publicly disclose poor material management. Wastefulness (pollution) and the potential to compromise public and environmental health were legislatively linked under the Act. This public accounting has had the positive effect of demanding that businesses find creative ways to integrate responsible environmental practices into day-to-day work practices. Many manufacturers have realized ancillary benefits from doing this and have become respected leaders in their communities.

- **A Safe and Healthy Workplace** — Eliminating fugitive emissions of hazardous chemicals not only preserves the environment but often promotes a safer and healthier workplace. Good housekeeping (including preventive maintenance) has always been and will continue to be the foundation on which efficiency in manufacturing and successful P2 programs are built.
- **Competitive Edge** — More and more businesses are finding that environmentally sound products and processes offer them distinct marketing advantages. Also, environmentally sound products and practices are more frequently demanded by consumers.
- **Continuous Improvement** — Pollution prevention provides a dynamic forum for auditing and implementing continuous quality improvements. Employees empowered to identify areas of improvement become instruments of change.

The Center's technical assistance and outreach activities for FY'94 are discussed in this chapter, and are tallied in Table 3-1.

TABLE 3-1: SUMMARY OF HWRIC OUTREACH AND ASSISTANCE, FY'94

Type of Outreach	Business	Business & Trade Assoc.	Citizens & Communities	Educ. Instit.	Gov't. Agency	Totals
Inquiries received by P2 staff	384	5	594	23	49	1,055
P2 Specific Assist.	207	5	308	13	32	565
Regulatory Questions	118	0	268	4	11	401
Governor's Awards Inquiries	27	0	0	0	0	27
Other ⁽¹⁾	32	0	18	6	6	62
Haz. Waste Database Searches	219	0	1	1	2	223
Clearinghouse Publications Distributed	2,507	0	1,585	1,153	1,660	6,905
Totals	3,494	10	2,774	1,200	1,760	9,238

(1) The Other category includes referrals to vendors, consulting firms, test laboratories, etc. or providing general information.

Inquiries to HWRIC are often handled directly by the engineers and scientists of the P2 Program staff. Most often the inquiries can be classified as P2-specific assistance, regulatory and compliance questions, requests for information on the Governor's Awards, or those of a more general nature (i.e. referral information).

Information from publications in our extensive Library and Clearinghouse collections frequently provide the desired answers for P2 inquiries. Annotated bibliographies on specific topics are often produced in response to inquiries. Many information inquiries are routed to the Information Services Program staff. The Center's library continued to supply the necessary training materials for the workshops and seminars that were provided during the year.

Specific requests for database information are filled by Data Management Section (DMS) staff. These requests are most often made by consultants conducting Phase I environmental assessments prior to sales of properties. HWRIC's hazardous waste database is searched to provide information on past waste activities in response to these requests.

During the year, the Center continued to add to our extensive collection of publications with a guidebook to P2 success stories and several reports documenting successful remediation strategies developed by HWRIC personnel and research collaborators (see Figure 3-1 on the following page).

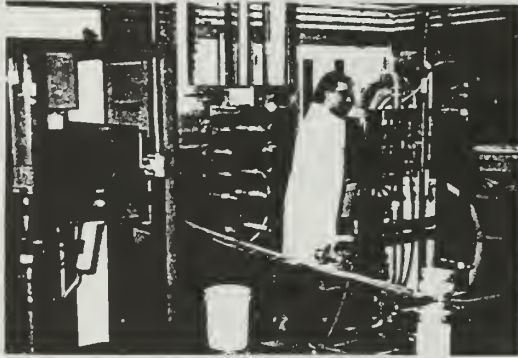
An important goal of the Center's P2 technical assistance staff is to create strong personal relationships with our clients, gaining the trust and cooperation of business people throughout Illinois. By doing so, we hope to establish partnerships that provide insight into the unique needs of the businesses with which we work. All this is done in confidence, without revealing trade secrets or proprietary technologies.

Site visits are the most effective way of gathering pertinent information about a business and laying the groundwork necessary for productive partnering. Such visits are done with the principal managers and employees at their places of business, to observe material flow, processes in operation and waste being generated.

In FY'94, one or more members of the P2 staff made 53 site visits. Most were initial visits where information was gathered and obvious P2 opportunities were explored. Several, however, involved full scale audits or follow-up visits at the request of our client. HWRIC staff have developed considerable expertise assisting fabricated metal manufacturers and electroplaters, as can be seen from Table 3-2 below. This expertise has been further extended through demonstration projects in our Pilot and Alternative Cleaners laboratories, as discussed in Chapter 5 of this report. The applied research capabilities that these laboratories provide Illinois' businesses are unique and will continue to be a major resource of our P2 efforts.

An important goal of HWRIC's pollution prevention technical assistance staff is to create strong personal relationships with our clients, gaining the trust and the cooperation of business people throughout Illinois.

Evaluation of Ultrafiltration to Recover Aqueous Iron Phosphating/Degreasing Bath



by

Timothy C. Lindsey, Alisa G. Ocker,
Gary D. Miller and Michelle C. Miller
Hazardous Waste Research and Information Center
Department of Energy and Natural Resources



January 1994
Printed on recycled paper



Ink and Cleaner Waste Reduction Evaluation for Flexographic Printers

by

Gary D. Miller and William J. Tancig
Hazardous Waste Research and Information Center
Department of Energy and Natural Resources
Michael J. Plewa
University of Illinois-Champaign
Institute for Environmental Studies



January 1994
Printed on recycled paper



Oily Waste Reduction and Recycling Pilot Test

by

Timothy C. Lindsey
Hazardous Waste Research and Information Center

and

Tony Montemurro
Outboard Marine Corporation-Waukegan



May 1994
Printed on recycled/recyclable paper



Pollution Prevention



Illinois Industry Success Stories



FIGURE 3-1: SOME KEY HWRIC P2 PUBLICATIONS FOR FY'94

TABLE 3-2: FY'94 SITE VISITS BY MANUFACTURING TYPE

BUSINESS TYPE	NUMBER OF VISITS BY P2 PERSONNEL
Fabricated Metals	16
Electroplaters	8
Auto Repair and Body Shops	5
Machine and Welding Shops	3
Railroads	2
Coil Coaters	2
Pharmaceutical Manufacturers Research Labs	3
Foundries	3
Oil Refineries (Crude and Vegetable)	8
Chemical Manufacturers	2
Others ⁽¹⁾	6
Total	53

(1) Includes a printer, major metal and appliance manufacturer, plastic and wood manufacturers, a pallet shop, and drum reconditioner.

While staff from most state technical assistance programs can talk about reduction practices, HWRIC staff can successfully demonstrate an effective technology to company personnel using their own wastestream. Such demonstrations provide company representatives the knowledge that a technology will work for them, leaving them only needing to decide whether the payback is worth the investment, which is a far more comfortable decision for executives and owners to make. We would like to see all of our P2 projects provide the kind of detail necessary for a company to make sound business decisions.

B. Assistance for Business

1. Regulatory Assistance

HWRIC personnel receive a significant number of requests for assistance from companies working to comply with general environmental regulatory requirements. Many small businesses lack the resources to hire full or even part time environmental staff. In response to small business requests, HWRIC personnel will explain regulatory requirements for various processes and wastes, determine what regulations a particular industry or facility may be subject to, and assist in the preparation of appropriate permit applications.

In responding to more complex regulatory questions, HWRIC staff work with regulatory agencies to assist company personnel in determining their specific requirements. HWRIC staff also serve as intermediaries between companies and regulatory agencies, in many cases assisting company personnel in framing questions to regulators so that they can gain a clear understanding of the requirements that pertain to them. The following examples are typical of the regulatory assistance that the Center provided during FY'94.

HWRIC staff sometimes serve as intermediaries between companies and regulatory agencies. In many cases, Center staff assist company personnel in framing questions to regulators so that they can gain a clear understanding of the requirements that pertain to them.

a. *Central Illinois Auto Body Shop Chain*

Staff at a firm that operates a chain of body shops in central Illinois were concerned about environmental compliance at their facilities. They were disposing of their hazardous wastes through a reputable waste broker, but wanted an outside person to come in to inspect their facilities and search for potential problems.

HWRIC personnel inspected the facilities. While they found no environmental violations, they were able to suggest improvements in waste and paperwork management practices that would help future inspections go more quickly. They also spotted several areas where fire protection practices needed to be improved.

b. *Chicago Area Still Manufacturer*

A chemical still manufacturer was building a pilot testing facility to test distill solvents for potential customers. They had enlisted the aid of a consultant to handle permitting issues on this project and asked HWRIC personnel to review the consultant's proposal. HWRIC personnel found that the proposal was inadequate in the areas that it addressed and left out important permitting considerations, in particular the need for an air pollution permit for the facility.

HWRIC personnel helped the firm evaluate its regulatory responsibilities, and assisted their staff in making appropriate notifications and applications to environmental regulatory agencies. This assistance effort saved the firm approximately \$20,000 and ensured that they were correctly permitted.

c. *Chicago Area Specialty Chemical Manufacturer*

A small chemical manufacturer in the Chicago area approached HWRIC for assistance in dealing with the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC). Grab samples of the firm's wastewater had been taken for billing purposes and the firm felt the levels of pollution detected in these samples was uncharacteristically high, leading to an unfairly high sewer use charge.

After examining the data, HWRIC personnel from both Champaign and Chicago advised the firm to have MWRDGC pull a 24-hour composite sample rather than a grab sample and split the sample with the MWRDGC for each to conduct tests. In both cases the new results indicated that the initial samples were not representative of the facility's effluent water discharges and the sewer rates were subsequently adjusted. Meetings also lead to several suggestions that could improve the firm's water use practices and general waste management practices.

2. Special Waste Declassification

In 1990, the Illinois Pollution Control Board adopted regulations requiring a degree-of-hazard evaluation of nonhazardous special wastes for companies that request declassification (removal of the wastes from regulatory oversight). Current Illinois regulations require that all industrial process wastes be disposed in special waste landfills (Title V, Section 21, subsection b of the *Illinois Environmental Protection Act*). Those wastes that are legally classified as hazardous wastes must be managed in appropriately permitted facilities (Title V, Section 21, subsection f of the *Illinois Environmental Protection Act*).

Nonhazardous industrial process wastes that are relatively innocuous and present no handling concerns can be declassified or “de-listed” by IEPA. Declassification allows companies to either use the waste for some beneficial purpose or to manage it much like municipal solid waste. Considerable cost savings frequently result from de-listing wastes.

Prior to 1990, HWRIC worked with the UIUC Institute for Environmental Studies to develop a degree-of-hazard evaluation computer program and database for use in evaluating industrial wastestreams. This program is in use by the IEPA and several companies. In addition, HWRIC assists companies in making degree-of-hazard evaluations.

During the past year, about 15 degree-of-hazard evaluations were performed for companies. The types of wastes evaluated included:

- Fabric and thread scraps
- Stabilized fly ash
- Boiler aggregate
- Glass
- Grain dust
- Vegetable meal
- Wood debris and sawdust
- Water-based ink washings, and
- Foam seal waste from petroleum storage tanks.

Over 3 million pounds per year of nonhazardous industrial wastes that were evaluated received low toxic scores and are good candidates for de-listing. The end result, if these wastes are declassified by IEPA, is that valuable special waste landfill space will be conserved and the cost of disposal for the generating companies will be reduced by more than half.

This fiscal year, over 3 million pounds of nonhazardous industrial wastes that were evaluated by the DOH system received low toxic scores and thus are good candidates for declassification.

3. Pollution Prevention Efforts

HWRIC subscribes to the belief that pollution prevention is not only sound business, but is also a responsible commitment to the community, and an important exercise in education and awareness. In numerous presentations, R. Buckminster Fuller often stated the problem simply: "Pollution is nothing but the resources we are not harvesting. We allow them to disperse because we've been ignorant of their value." This is not to say that industry leaders lack intelligence or integrity, but rather that they are often unaware of the opportunities to save money and to run the more efficient operations that practicing P2 strategies can afford them. Quite often this is caused by a lack of in-house technical expertise or by the fear that sound environmental practices can't be effectively integrated into the working practices of their business without compromising competitiveness, financial health, or customer satisfaction. Nothing could be further from the truth if the process is properly planned and astutely implemented.

HWRIC subscribes to the belief that pollution prevention is not only sound business, but is also a responsible commitment to the community.

It is the charge of HWRIC's Pollution Prevention Program to work with companies and organizations to mitigate these concerns, to build the trust necessary to foster confidence in our recommendations and in the technologies we have developed or demonstrated for them. Although the opportunities for pollution prevention are often obvious to the trained eyes of our technical assistants during a site assessment, and can be pointed out to company personnel, the real, longterm value of HWRIC's assistance to an organization is fully recognized only when we help their staff to develop their own sets of trained eyes.

Employees, particularly floor workers, have the greatest impact on reducing losses and improving operating efficiency, but upper level management must express a commitment to pollution prevention and operating efficiency, and must let employees know these approaches are an important aspect of their job performance and essential to the long term success of the business. We only consider our work a success when we have shown the businesses we work with that pollution prevention pays and when they make P2 an integral part of their business operations. The following are specific examples of P2 partnerships that were particularly fruitful this year.

a. First Presbyterian Church of Edwardsville

HWRIC personnel were contacted by the pastor of a church that was participating in a Model Community program. Church staff were evaluating the cleaning chemicals used by their janitorial staff as part of this program. HWRIC staff examined material safety data sheets (MSDSs) that had been supplied to the church by chemical vendors, and identified several chemicals that could be replaced by more environmentally sensitive products. In particular, some highly corrosive cleaners were replaced with much milder soaps and detergents. More importantly, several chemicals were identified which could have resulted in the release of lethal gas if they were accidentally mixed together. HWRIC's assistance helped the church ensure the safety of their janitorial staff and helped all staff become more environmentally responsible.

b. Chicago Area Roll Coater

A Chicago area roll coater (a firm that prepaints rolls of steel for subsequent use by manufacturing plants) needed assistance in initiating a P2 program for its Illinois facilities. HWRIC personnel provided written materials, including our 1993 guidance manual, *Pollution Prevention: A Guide To Program Implementation*, and conducted seminars on three occasions for personnel from the company's plants. These seminars introduced them to the idea of pollution prevention and initiated intra-staff discussions that improved environmental management and process efficiency at the facilities.

c. Central Illinois Vegetable Oil Refiner

A small central Illinois vegetable oil refiner approached HWRIC personnel to review their P2 plans and to assist in a brainstorming session with plant personnel. During this session, it was suggested by HWRIC personnel that one of the plant's most voluminous and problematic wastestreams, spent filter slag, might be reduced or eliminated by the application of the ultrafiltration membrane technologies HWRIC staff are developing. HWRIC personnel were instrumental in initiating a study of the potential technology change, which at this point is still in progress.

d. Diamond Cutting Tool Manufacturer

HWRIC personnel visited a diamond cutting tool manufacturer at their request. Several pollution prevention options were presented for their nickel electroplating operation, including drag-out recovery methods, rinse water reduction techniques, and employee involvement in P2. The company is interested in implementing countercurrent rinsing and trying recovery equipment, such as evaporation or reverse osmosis, for the rinsewater.

HWRIC staff from Chicago and Champaign followed-up with a subsequent visit, during which they discussed rinsewater reduction and metal recovery options that could be tested in the Center's Pilot Laboratory.

e. Auto Parts Rebuilder

Center staff conducted a site assessment at an auto parts rebuilder site. A report was prepared, including P2 suggestions for drag-out recovery methods, rinsewater reduction techniques, chlorinated solvent elimination and formal pollution prevention program implementation for employee involvement. The company also had several regulatory questions and process concerns that were addressed.

f. Electroplater

A job shop electroplater requested assistance in identifying opportunities to achieve compliance with sewer discharge limits. The company does not perform any wastewater treatment on the discharged plating rinses. The company was interested in evaporators and electrowinning (a process used to recover elemental metals from plating baths).

After discussions with Center staff, the company has decided to install evaporators and change rinsing practices to minimize rinsewater. This will eliminate all metal-bearing rinsewater from sewer discharges.

A written report was issued to summarize the assistance work performed which included information on evaporators, electrowinning and cyanide destruction.

4. Lab Assistance to Businesses

HWRIC's Laboratory Services Program (LSP) provides analytical assistance to Illinois firms working with the Center's P2 Program (see Figure 3-2). In some instances, businesses have worked directly with lab staff. For example, the LSP worked with Illinois Power and Caterpillar to provide analytical support to their in-house research activities. Similar support was given to a University of Illinois, Urbana-Champaign (UIUC) class working with Armstrong World Industries.

Illinois Power was interested in exploring corrosion problems in their Clinton Power Station reactors during the annual shutdown for maintenance. They asked that HWRIC apply its ability to do metals analysis in water at very low detection levels to several hundred cooling water samples collected during the maintenance period and after restart. The data have been instrumental in determining what effect corrosion has on the normal operations of the plant.

Caterpillar was involved in a research project involving diesel engine emissions. They were unable to find a lab in the private sector who could provide the methods development and sophisticated analysis they required to support their research efforts. The LSP provided all of the analytical information that they required to evaluate the progress of their research.

The Center's Laboratory Services Program provides analytical assistance to Illinois firms working with the Center's Pollution Prevention Program.



**FIGURE 3-2: CHEMIST ANALYZING OIL AND GREASE
IN AID OF TECHNICAL ASSISTANCE EFFORT**

The Armstrong World Industries effort grew out of a class project in General Engineering at UIUC. A group of students was assisting Armstrong in identifying volatile organic emissions from their flooring lines in the company's Bourbonnais facility. HWRIC agreed to provide help with the sample collection and analysis.

The project continued into the second semester and has now grown into a research effort jointly funded by Armstrong and HWRIC, with the LSP continuing to provide consultation and sample analysis on the project. Armstrong representatives have visited the Center and have collaborated directly with LSP staff in trying to identify sources of undesirable emissions from their process lines.

The goal of the project is to identify and implement source reduction methods on Armstrong's process lines. The results will be documented in terms of quantities of waste reduced and cost savings.

5. Small Business Assistance

a. *Class V Shallow Injection Well Program*

HWRIC has received a grant from USEPA Region V to assist businesses in Peoria and Tazewell counties in finding alternative ways to dispose of hazardous fluids that are presently being disposed of in shallow underground injection wells (Class V wells).

The Class V well project is a USEPA Region V initiative to identify and close, within geographically targeted areas, Class IV (banned) and Class V wells that are being used to inject fluids which exceed Maximum Contaminant Levels (MCLs), or are used to dispose of or accumulate hazardous waste. Class V well injection is not intended for injection of hazardous waste fluids into the environment, but does involve the injection of nonhazardous chemicals and fluids into, between, or above underground sources of drinking water (USDW).

Improper use of injection wells of this type has the potential to place fluids containing contaminants (e.g. photograph laboratory chemicals, automotive greases and oils, waste solvents, antifreeze, and gasoline) into close proximity with groundwater that may be used for drinking water. Many such wells are believed to be in noncompliance with Safe Drinking Water Act (SDWA) and Resources Conservation and Recovery Act (RCRA) regulations.

Class V wells include storm water runoff dry wells, floor drains connected to septic systems, industrial waste disposal wells, cesspools, and irridrain systems that drain to surface waters or dry wells. (Initiative requirements do not apply to conveyances connected to city or village sewer systems or to single family and nonresidential septic systems or cesspools the sole use of which is for the disposal of sanitary waste and which have a capacity to serve fewer than 20 persons a day.)

HWRIC used a database furnished by the USEPA to mail an information package to over 5,300 Peoria and Tazewell county businesses. The outreach package contained Class V well information, Best Management Practices for users of Class V wells, information on the services provided by HWRIC, and general pollution prevention literature. USEPA will later contact the same list of businesses with a questionnaire addressing their methods of waste disposal.

The USEPA grant also provides funding for presentations to business and trade associations, industry-specific workshops, and on-site assessments. A toll free telephone assistance line (800/407-0261) has been established at HWRIC to field questions pertaining to the project or to request technical assistance on dealing with Class V wells.

A toll free telephone assistance line — 800/407-0261 — has been established at HWRIC to field requests for technical assistance on dealing with Class V wells.

Project activities have included six seminar presentations, three on-site technical assessments, and one workshop. Technical and administrative assistance, via the 800 telephone number, has been provided to over 1% of the thousands of businesses contacted thus far.

6. Technology Development and Demonstration Projects

During technical assistance site visits to industrial facilities, HWRIC engineers often identify opportunities for companies to reduce wastes by modifying industrial processes. In some instances, HWRIC personnel recommend conducting pilot testing to evaluate a process modification or new technology. HWRIC personnel often design these projects and coordinate their execution with facility personnel.

The projects summarized below provide a sampling of technical assistance activities where HWRIC engineers have actually tested process modifications that can reduce waste generation at industrial facilities.

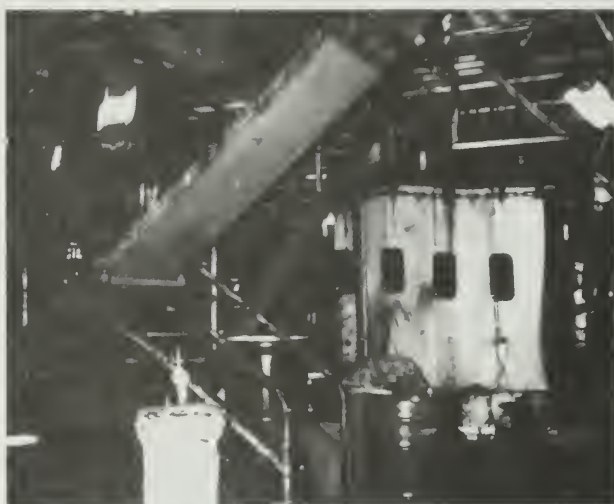


FIGURE 3-3: WAGONS ON THE LINE AT RADIO FLYER

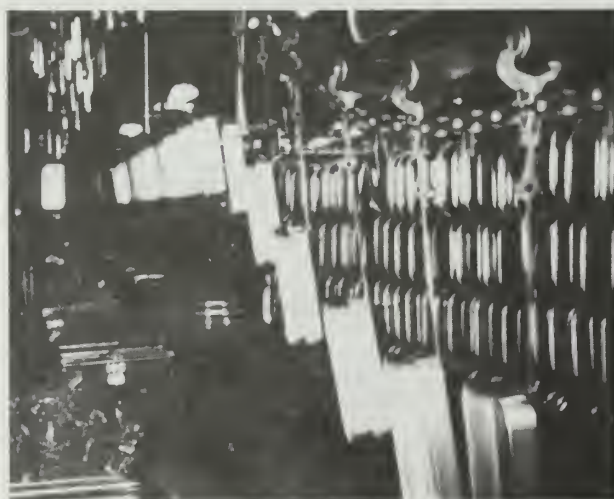


FIGURE 3-4: PRE-CLEANING BATH LINE AT RADIO FLYER

a. Radio Flyer

Radio Flyer (RF) manufactures children's wagons at their Chicago facility. RF personnel contacted HWRIC engineers regarding a waste problem associated with degreasing the wagons prior to painting operations (see Figure 3-3).

RF's degreasing operation was resulting in the discharge of approximately 6,000 gallons of spent degreasing solution to the sanitary sewer on a biweekly basis. HWRIC staff conducted a site assessment of the Radio Flyer facility and determined that incorporation of an ultrafiltration system into the degreasing operation might significantly extend the life of the degreasing solution and reduce the waste discharges.

HWRIC engineers conducted on-site testing of an ultrafiltration unit at the RF facility to filter oil and grease contaminants from the degreasing solution (see Figure 3-4). The quality of the degreasing solution was monitored for approximately two weeks before and two weeks after the ultrafiltration system was installed.

Figure 3-5 shows the impact that the ultrafiltration system had on the degreasing solution. The ultrafiltration unit was effective at maintaining the contaminant levels at less than 0.02% over a 2 week period.

Based on the results of this testing, Radio Flyer chose to purchase a permanent ultrafiltration system to be installed as an in-process recycling procedure within their existing degreasing process. Radio Flyer anticipates a savings of over \$50,000/year associated with a reduction in both chemical use and waste disposal costs. Additionally, waste volumes associated with reduced dumping of the degreasing tanks will be decreased by approximately 75%.

b. Ace Hardware, Paint Division

Officials from Ace Hardware’s paint division contacted HWRIC engineers for assistance regarding latex wash water wastes generated at their paint manufacturing facility in Matteson. A bulk sample of the wash water was brought to the HWRIC Pilot Laboratory to evaluate the potential for using centrifugation and ultrafiltration for recycling the wash waters.

Based on pilot testing, it was determined that use of a solid-liquid centrifuge was effective at removing the majority of latex from the wash water. However, the water generated from the centrifuge had to be further processed through an ultrafiltration membrane to thoroughly remove the remaining latex from the wash water. This two step centrifugation/ultrafiltration process appeared to be an effective method for removing the latex.

Ace officials believe that the recovered latex could be reintroduced into the paint manufacturing process resulting in virtually zero waste being generated from the process. Ace plans on renting centrifugation and ultrafiltration equipment to be installed at the Matteson facility for full-scale testing of this process. It is anticipated that HWRIC engineers will play a prominent role in this testing.

c. Fulton Corporation

Fulton Corporation manufactures mailboxes at their Fulton facility. They utilize a dip tank charged with 1,1,1, trichloroethane to degrease the mailboxes prior to painting. Representatives from Fulton were aware that this solvent will no longer be available after 1995 due to provisions in the 1990 Clean Air Act Amendments that restrict the use of ozone-depleting solvents. Therefore, Fulton contacted HWRIC during efforts to evaluate cleaning alternatives.

HWRIC personnel evaluated various aqueous cleaning systems for Fulton in HWRIC’s alternative cleaners laboratory. Additionally, HWRIC personnel conducted bench scale ultrafiltration testing to determine the potential for this technology to facilitate in-process recycling of the aqueous cleaning solutions. HWRIC engineers will continue to work with Fulton as they implement their new cleaning system in the plant.

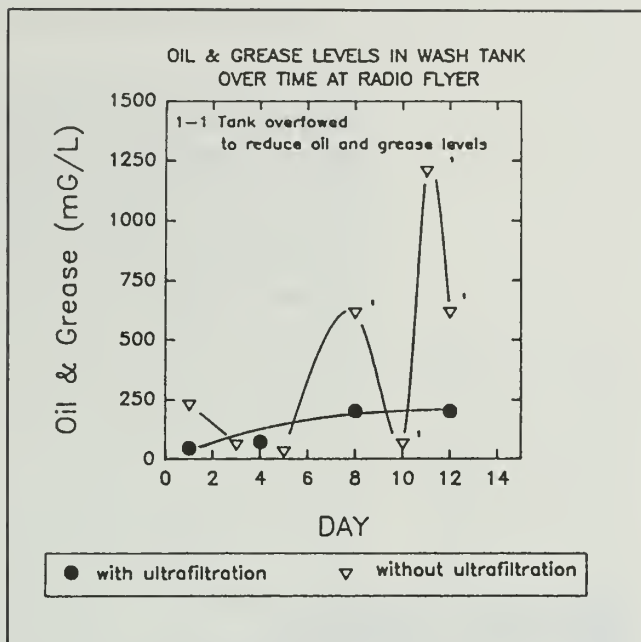


FIGURE 3-5: GRAPH OF OIL AND GREASE LEVELS IN THE RADIO FLYER WASH TANK

d. *Burlington Northern Railroad*

HWRIC engineers have been working with Burlington Northern (BN) Railroad's Galesburg facility since October, 1993 to develop a facility-wide P2 program. As a result of implementing this program, BN has experienced a 20% decline in both volumes and costs associated with hazardous waste generation. During the course of program implementation, several opportunities for incorporation of pollution prevention technologies into BN's processes were identified, and HWRIC engineers provided technical assistance toward that end.

BN uses aqueous-based caustic cleaners to degrease parts in their locomotive maintenance shop. The cleaners are applied with two separate spray washers with capacities of 2,000 and 9,000 gallons, respectively. Due to a buildup of oil and dirt, these washers are dumped on a biweekly schedule. The spent cleaner requires significant treatment at BN's wastewater treatment plant prior to discharge to the sanitary sewer, and the lost cleaning chemicals are very costly to replace.

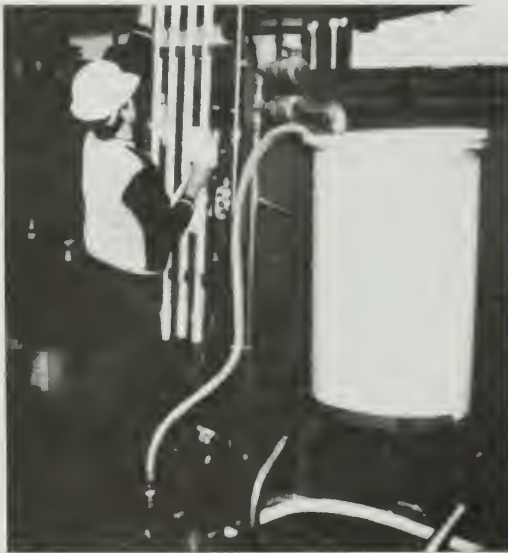


FIGURE 3-6: BURLINGTON NORTHERN'S
ULTRAFILTRATION UNIT

HWRIC engineers conducted pilot-scale ultrafiltration testing on the 2,000 gallon parts washer to determine its effectiveness at extending the life of the caustic solution (see Figure 3-6). The ultrafiltration system was effective at removing contaminants from the solution. Further testing needs to be conducted to determine the size of equipment that would be required for permanent installation.

The wastewater treatment plant at BN's Galesburg facility receives effluent from all their facility operations. The sludge generated at this facility is comprised of a mixture of water (70 - 80%), oil (10 - 20%) and solids (5 - 15%). Disposal of this sludge tends to be costly due to its liquid nature and relatively large concentration of hydrocarbons. HWRIC engineers worked with BN representatives to test a centrifuge to effectively remove the solids from the sludge and facilitate separation of the oil and water phases.

Pilot-scale testing conducted at the Galesburg facility indicated that the centrifuge is effective at removing the solids from the sludge. Additionally, the oil/water mixture produced by the centrifuge can be placed in a settling tank whereby the water can be decanted thus enabling the oil to be removed for recycling. BN plans to rent a centrifuge to conduct further longterm testing of this process. HWRIC will continue to work with BN representatives to more thoroughly evaluate both the ultrafiltration and centrifugation technologies at the Galesburg facility.

e. *Eco Finish, Inc.*

Eco Finish manufactures various metal parts using stamping and forming processes at their facility in Montgomery. The parts are shaped, cleaned, phosphatized and painted prior to shipment to customers. The cleaning/phosphatizing operations at the plant generate wastewater. The facility is not connected to municipal sanitary sewer

facilities. Therefore, Eco Finish had no practical means for properly disposing of their spent degreasing/phosphatizing solution.

Eco Finish representatives contacted HWRIC engineers through the Valley Industrial Association to investigate methods for dealing with this wastestream. HWRIC engineers designed and installed a closed-loop system using ultrafiltration membranes to continuously recycle the cleaning/phosphatizing solution. The system proved to be very effective and, consequently, Eco Finish installed a permanent system at the facility. Implementation of this system resulted in significant cost savings and waste reduction. Additionally, it enabled Eco Finish to continue operating at this facility. This might not have been possible if an effective recycling option had not been implemented.

7. Alternative Cleaners Evaluation

HWRIC has been investigating techniques and technologies designed to reduce or eliminate the use of hazardous organic solvents in Illinois manufacturers' cleaning processes. This is part of a two year project funded by USEPA's Pollution Prevention Incentives for States Program (PPIS). Solvents to be eliminated are those specified in the federal Clean Air Act Amendments (CAAA) of 1990 and the federal *Pollution Prevention Act of 1990*. The principle target solvents are chlorinated hydrocarbons (chloroform, methylene chloride, perchloroethylene and 1,1,1-trichloroethane), glycol ethers and ketones. These solvents are most often used to remove oils and grease from metal parts, ink from presses, and paint overspray. The Center's initial efforts have focused primarily on working with Illinois industrial metal fabricators.

In order to test multiple cleaning possibilities, HWRIC engineers have designed and built the Solvent Alternatives Testing Unit. This unit is a portable system of tanks and pumps, as shown in Figure 3-7.

Many varied cleaning options are built in to the system, including low pressure spray nozzles, varying agitation conditions (i.e., ultrasonics, air sparging and subsurface jets), and heating units which allow for temperatures up to 250°F. Other electives which can be tested with the system include rinsing conditions, differing water types, and time variables.

Below are short reviews of some of the companies we have assisted in FY'94 as part of this project.

With support from USEPA's Pollution Prevention Incentives for States Grant Program, HWRIC has been investigating techniques and technologies designed to reduce or eliminate the use of hazardous organic solvents in Illinois manufacturers' cleaning processes.



FIGURE 3-7: SOLVENT ALTERNATIVES UNIT

a. *Harris Corporation*

Harris Corporation manufactures electronics equipment at their Quincy facility. At their request, Center staff are helping to evaluate alternatives to their existing parts cleaning operations which use methylene chloride in a vapor degreasing operation. Through utilization of HWRIC's alternative cleaners laboratory, many aqueous-based cleaners have been investigated as possible replacements for the methylene chloride degreaser.

A cleaner has been chosen for their aluminum parts manufacturing line and will soon be implemented. HWRIC engineers will also assist Harris in the evaluation of an ultrafiltration system for recycling their cleaning solution. This company will reduce solvent use by at least 80% as a result of these efforts.

b. *Danville Metal Stamping*

Danville Metal Stamping, Inc. (DMS) manufactures jet engine parts at their Danville facility. HWRIC staff members presented a P2 overview to DMS staff as part of an effort to encourage a broad-based program at their facility. Implementation of this program has not yet begun, although DMS personnel have visited the Center and HWRIC engineers have demonstrated the Alternative Cleaners Testing unit.

DMS parts require stringent cleanliness specifications, demanding an exacting cleaning operation. HWRIC staff are working on alternatives to the perchloroethylene (PCE) vapor degreaser currently used at DMS for removing a tooling compound. This complex problem is further complicated by the relatively high melting point of the wax and the metals used in the process.

HWRIC staff have explored many types of parts cleaning, including supercritical fluid, aqueous, terpene, ultrasonic, steam and ester-based. To date none of the processes tested have cleaned the parts to the rigid standards required by DMS. HWRIC staff will continue to evaluate new cleaners as they become available. Several new products with good potential are scheduled for testing in the coming year.

c. *Twinplex*

Twinplex manufactures steel battery casings at their Wooddale facility. Twinplex personnel contacted HWRIC staff for assistance with their efforts to replace a mineral spirits degreaser. The battery casings are required to meet strict cleanliness restrictions, but Twinplex was unable to get an accurate measurement on the necessary level of cleanliness. Initial observations by Twinplex suggested that the aqueous-based cleaner they converted to was not doing the job as well as the solvent cleaner. Through cleanliness testing at HWRIC, Twinplex was able to formulate a new cleaner which met their needs.

8. Pilot Laboratory Equipment Capabilities

HWRIC's support and promotion of P2 efforts at Illinois companies often includes demonstrations or testing of processes that will reduce waste at the source, or that can use alternatives to more hazardous products. Testing is also done on industrial process and waste streams to identify opportunities for pollution prevention (see case studies above).

Often HWRIC engineers rely upon the pieces of equipment in the Center's 1,450 square foot Pilot Laboratory, which are described below. Previous Center annual reports, particularly our FY'92 report, describe Pilot Lab equipment in greater detail.

a. Centrifuge — Solid/Liquid

This basket centrifuge is designed to separate solids from liquids without consumable filtration elements. Depending on the application, the materials collected can have volume reductions of up to 85%. Some common industrial applications for this centrifuge include paint waste handling, and the removal of metal fines from grinding coolant or industrial oil. Center staff often use this centrifuge for pretreatment of solutions before they are subject to ultrafiltration.

b. Centrifuge — Liquid/Liquid

This disc-stacked separator is designed to break and separate various emulsions along with some finely dispersed solids. A retaining bowl is used to remove fine solids while liquids are separated by density. The unit is often used to clarify colloidal or opaque liquids such as contaminated coolants and cutting oils, hydraulic fluids, lube oils, and wash liquids.

c. Ultrafiltration

Ultrafiltration (UF) employs low pressures to force liquids through membranes containing varying pore sizes to afford separations based on molecular or aggregate size. The UF unit is often used to remove oils, bacteria, and other large molecules from process solutions. The Center has been very successful using ultrafiltration to remove emulsified oils from parts cleaning baths in the metal fabricating industry.

d. Reverse Osmosis

Similar to ultrafiltration, reverse osmosis (RO) passes liquids under high pressures through micropore membranes. RO is very effective at removing dissolved solutes such as heavy metals, complex ions, and dissolved oils from industrial process streams. This technology has been used in the electroplating industry to remove toxic metals, thus conserving and recycling desirable plating metals from solution.

e. *Vacuum Evaporation*

The vacuum evaporator unit processes solutions by removing volatiles that boil below the boiling point of water. It functions much like a distillation column. By applying vacuum, the effective boiling point of the liquids is lowered, requiring less energy to effect the separations. Vacuum evaporation is especially useful in concentrating solutions beyond the capabilities of ultrafiltration and reverse osmosis systems.

HWRIC's training and outreach efforts were focused on reaching consultants, businesses and government agencies with pollution prevention information. Appendix A of this annual report includes a comprehensive listing of all articles, reports and seminars published or delivered during the year.

9. Training and Workshops

In FY'94, HWRIC's training and outreach efforts were focused on reaching consultants, businesses and government agencies with pollution prevention information. Many presentations were made to various industry associations as well as university classes. As a result of many of these presentations, companies requested technical assistance, information and site visits.

Summary descriptions of the more significant training and workshop efforts undertaken during the year are summarized in this section. For more detail, Appendix A of this annual report includes a comprehensive listing of all articles, reports and seminars published or delivered during the year.

a. *Automotive Services Industry Workshop*

HWRIC, the City of Pekin and the Pekin Groundwater Protection Committee sponsored a half day workshop on June 2, entitled "Automotive Service Station Clean Bay Workshop." The workshop was funded as a part of the Class V well project supported by USEPA (see earlier discussion). At the clean bay workshop, HWRIC staff made presentations on:

- HWRIC services and regulatory issues
- Illinois Groundwater Protection Act
- Class V Shallow Injection Well practices
- Environmental Rules of Thumb and Best Management Practices for automotive service related industries, and
- Preparing a process flow diagram.

b. *Consultants*

In April, a workshop designed to demonstrate the benefits of P2 was conducted specifically for consultants who are trying to offer pollution prevention services. There were 55 people in attendance at this Chicago workshop, including five representatives of industry. Topics included how to assist companies in developing P2 programs, evaluating and measuring the benefits of P2, and case studies of successful technologies.

c. *Government Agencies*

One of the first activities of the Greater Chicago Project (described in detail in Chapter 4 of this report) was to present a workshop to regulatory staff (permit writers and inspectors) of USEPA, IEPA, the City of Chicago and the MWRDGC. Three of these training workshops were conducted. The purpose of the training was to familiarize the attendees with P2 concepts and basic techniques, as well as technical assistance services available to companies. As a result, inspectors and permit writers from these agencies will be better able to identify companies that are good candidates for HWRIC's regulatory and P2 assistance services.

d. *Industry*

On June 8, HWRIC, DCCA and IEPA cosponsored a regional teleconference on P2 techniques for spray painting operations. Participants learned about current and pending regulations governing the use of spray painting as well as new techniques and technologies to assist with decreasing emissions and waste generation. Downlink sites were located in Chicago and Rockford. Presentations covered specific equipment and paint formulations and several case studies were described.

As part of the Greater Chicago Project, HWRIC technical assistance staff presented a P2 workshop to regulatory staff of USEPA, IEPA, the City of Chicago and the Metropolitan Water Reclamation District of Greater Chicago.

C. Governor's Awards Program

1. Seventh Annual Awards Presentation

On September 22, 1993, HWRIC hosted the Seventh Annual Governor's Pollution Prevention Awards luncheon ceremony at the Governor's Mansion in Springfield. The competitive awards and certificates recognize exemplary Illinois businesses and organizations that practice pollution prevention/source reduction. Figure 3-8 illustrates the locations of the award winners for the seven competitions.

For the 1993 awards, Governor Jim Edgar recognized fifteen (15) companies and organizations for their exemplary efforts to reduce and prevent waste.

At the Awards Ceremony, nine (9) awards and six (6) certificates of recognition were presented to Illinois industries and organizations in seven categories (Tables 3-3 and 3-4 on the next page).

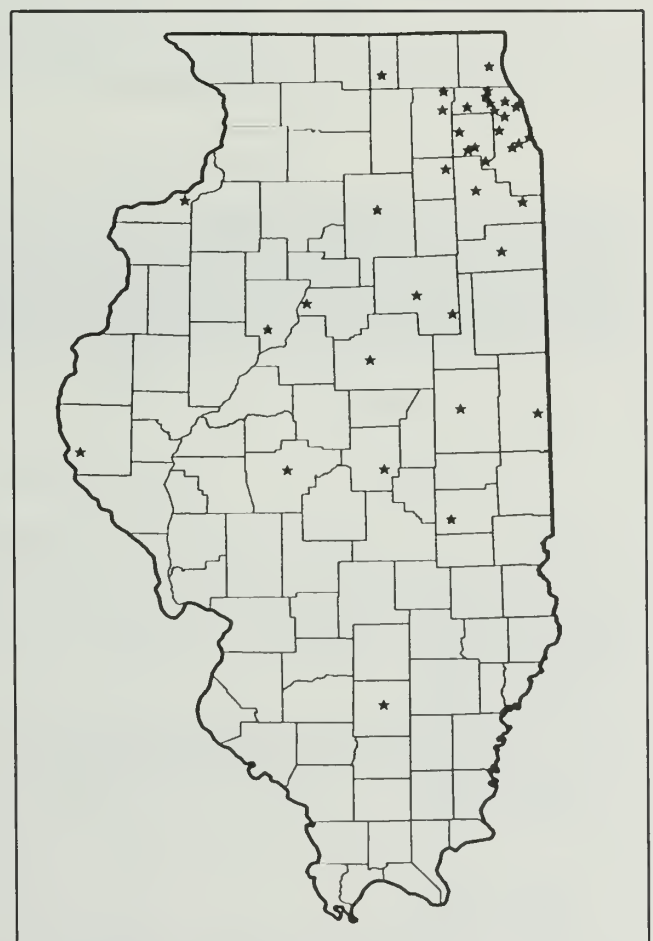


FIGURE 3-8: LOCATIONS OF GOVERNOR'S AWARD WINNERS, 1987-1993

TABLE 3-3: 1993 GOVERNOR'S AWARD WINNERS

SEVENTH ANNUAL GOVERNOR'S POLLUTION PREVENTION AWARDS WINNERS	
Category	Organization
Vendor	Nalco Chemical Company - Naperville, IL
Community Group	Aurora Sanitary District - Oswego, IL
Educational Institution	University of Illinois at Urbana-Champaign Urbana, IL
Small Facility (1-150 Employees)	Griffin Wheel Company - West Chicago, IL
Medium Facility (150 - 500 Employees)	Harris Corporation, Broadcast Division - Quincy, IL G.E. Plastics - Ottawa, IL
Large Facility > 500 Employees	Motorola, Inc. - Schaumburg and Liberty, IL Mobil Oil Corporation - Joliet, IL

TABLE 3-4: 1993 GOVERNOR'S CERTIFICATE WINNERS

SEVENTH ANNUAL GOVERNOR'S POLLUTION PREVENTION CERTIFICATE WINNERS	
Category	Organization
Trade Organization	Chemical Industry Council of Illinois - Rosemont, IL
Vendor	Chicagoland Processing Corporation - Mt. Prospect, IL
Community Group	Central States Education Center - Champaign, IL
Small Facility (1-150 Employees)	R.B. White, Inc. - Bloomington, IL
Medium Facility (150 - 500 Employees)	Arens Controls, Inc. - Evanston, IL
Large Facility > 500 Employees	Tellabs Operations, Inc. - Lisle, IL

Representatives of each award- and certificate-winning organization attended the event. The winners expressed their appreciation that both Governor and Mrs. Edgar were in attendance and that the Governor presented the awards.

Following the award ceremony, two companies, Tellabs, Inc. and Griffin Wheel Company, requested re-presentation of their awards or certificates at their facilities. Each ceremony gave the company leaders the opportunity to share the honor with all of their employees.

It is generally the employees who implement and perpetuate successful P2 activities, and the re-presentations are a way to recognize many of their efforts.



FIGURE 3-9: GOVERNOR EDGAR PRESENTS A CERTIFICATE TO CATHY GREEN OF CENTRAL STATES FOR THEIR MODEL COMMUNITIES PROGRAM

a. Tellabs, Inc.

The Certificate of Recognition for Tellabs, one of the large facility winners, was re-presented at Tellabs' new manufacturing facility in Bollingbrook on September 24 by HWRIC's Assistant to the Director, as part of their open house celebration.

b. Griffin Wheel Company

The Griffin Wheel Co. facility in West Chicago manufactures railroad car brake shoes. Participating in the December 3 award re-presentation were: Lt. Governor Bob Kustra; West Chicago Plant Manager, Alan Somolik; Griffin Wheel President, Arthur Goetschel; State Representative Thomas Johnson; West Chicago Mayor Steven Lakics; and HWRIC's Director and Assistant Director. Griffin's award was re-presented in a ceremony on the plant floor.

3. Eighth Annual Governor's Pollution Prevention Awards

Early in 1994, HWRIC's Pollution Prevention staff began coordinating the Eighth Annual Governor's Pollution Prevention Awards for waste reduction activities undertaken in 1993. HWRIC mailed out numerous applications, assisted applicants with their forms, and coordinated the awards ceremony with the Governor's Office.

Some 41 applications for the eighth annual awards competition underwent review in May of 1994. The competition for the 1994 awards was stiff, because applicants, in general, showed more sophistication in their P2 efforts than in previous years.

The competition for the 1994 awards was stiff, because applicants, in general, showed more sophistication in their P2 efforts than in previous years.

The nominees for the awards were judged on the following criteria:

- Project/program/technology
- Waste volume/toxicity reduction
- Management commitment
- Employee participation
- Benefits to workers, community, environment, and
- Relevance to other industries.

A HWRIC panel reviewed and rated the applicants using the above guidelines and forwarded their selection recommendations to IEPA who reviewed the compliance status of each. Final recommendations were then passed along to the Governor's Office. This year's awards will be presented in the Governor's Springfield Mansion on September 22, 1994.

TABLE 3-5: 1994 AWARD RECOMMENDATIONS

RECOMMENDATIONS FOR THE EIGHTH ANNUAL GOVERNOR'S POLLUTION PREVENTION AWARDS		
Category	Number of Awards	Number of Certificates
Community Group	0	1
Educational Institution	0	1
Trade Organization	0	1
Vendor	1	2
Small Facility	1	1
Medium Facility	1	1
Large Facility	2	1
Total	5	12

D. Citizens and Communities

As shown in Table 3-1 in the introduction to this chapter, over 1,500 individual citizens and/or community organizations requested information or assistance from Center staff in FY'94. A few of the responses to these requests are highlighted below.

1. Technical Assistance and Information

a. Commercial Property Owner

HWRIC personnel assisted the owner of a commercial property to determine if the three leased businesses on the property were complying with environmental regulations. The businesses were:

- An automotive transmission repair franchise,
- An automotive painting franchise, and
- A public service organization.

Recommendations made to the automotive transmission franchise were that they: establish a wastewater disposal plan in compliance with local ordinances; substitute the aqueous cleaner being used in one shop area to clean parts for the combustible parts cleaner being used in another area; and, contact an oil recycler to remove used oil and oil contaminated "floor dry."

Recommendations to the automotive painting franchise were that they: seal a floor drain used to wash down shop floor residuals; discontinue use of another floor drain used to clean paint spray equipment; consider use of a commercial paint gun recirculating solvent sink; and, purchase drums to store used paint spray booth filters in lieu of immersing them in vendor-filled drums of water.

A general recommendation was made to the owner of all these commercial properties to contact an environmental attorney to determine the legality of a tenant/owner agreement which covers tenant responsibility for environmental cleanups.

2. Hazardous Waste Database

HWRIC's hazardous waste database (actually multiple, linked, databases) is used to identify sites of potential concern on or near properties being sold. Interest in this type of information has increased in Illinois since the adoption of the *Illinois Responsible Property Transfer Act* (PA 85-1228, effective in 1990). This law requires that the parties involved in a real estate transaction make the buyer aware of the environmental condition of a property.

Standards have also been developed on the national level for conducting Phase I environmental site assessments. These standards include using environmental databases as part of routine screening work prior to the sale of a property.

HWRIC staff search the database for location information on landfills, surface impoundments, and other types of disposal sites in response to requests from individuals conducting preliminary site assessments.

In FY'94, HWRIC added the Historical Hazards Geographical Information System (GIS) database to its collection.

During FY'94, HWRIC added the Historical Hazards Geographical Information System (GIS) database to its collection. This database was developed by the Illinois State Museum and is based on the Sanborn Fire Insurance maps. Researchers at the State Museum used their knowledge of historic industrial practices to identify, from the Sanborn Maps, locations of businesses likely to have used various hazardous chemicals. The database covers urban areas of over 500 Illinois cities with information dating as far back as 1849 and up through 1950 (see Chapter 6 of this annual report for more information).

The addition of this system to the Center's database resources has increased the number of requests received for database information. Over 220 requests for information from the hazardous waste database were filled during FY'94, as noted on Table 3-1 in the introduction to this chapter. This compares to approximately 60 requests filled last year.

3. 1993 Illinois State Fair

"Pollution Prevention in Agriculture and Industry" was the theme of HWRIC's display for this Illinois State Fair. Drawing on the expertise and visual materials of several of the agricultural and industrial contacts HWRIC has made via technical assistance efforts, HWRIC staff compiled a three-part display on ways in which waste generation can be stopped before it even starts (see Figure 3-10).

Topics illustrated in the state fair display included:

- Variable rate technology (VRT) which, utilizing Global Positioning System satellite data with a terrain data computer, linked to a detailed soil map database, allows the application of the optimum amount of fertilizer or chemical needed in a crop field. The VRT system was pioneered in Illinois by Illini Farm Supply (FS) and is currently available in several central Illinois regions.
- Dry powder paint industrial paint application systems that do not require the solvents needed by wet paint systems, and allow the paint particles to flow together to form an evenly coated surface, using only the amount of paint required.
- A HWRIC pilot laboratory project investigating methods to reduce the volume of toxic waste produced from cleaning petroleum storage tanks. The ultimate goal of the project is to emulsify the sludge at the bottom of the storage tanks, allowing for efficient cleaning and recovery of reusable oil.

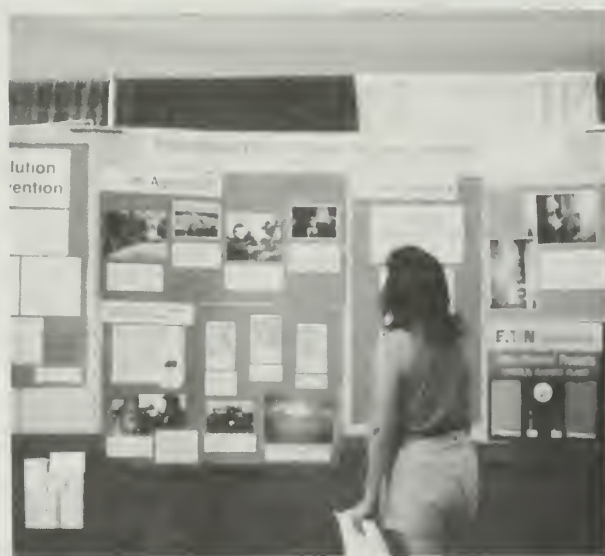


FIGURE 3-10: HWRIC's STATE FAIR DISPLAY

4. Great Flood of 1993

HWRIC was able to provide some assistance to citizens and communities in western Illinois suffering damage and pollution problems in the wake of the Great Flood, primarily on the Mississippi and Illinois rivers. Several HWRIC staff members joined Energy and Natural Resources colleagues in staffing sandbagging lines during the worst of the flood.

Cooperative Extension Service staff in western Illinois had been getting inquiries from residents who found household cleaning products and paint products floating near their damaged homes or mired in silt in the houses. At the request of the Extension Service, HWRIC staff compiled basic information on our services and on ways to handle and dispose of hazardous household products. The Extension Service posted this information on their Internet GOPHER server, which is used by Extension staff in counties across the state. This newer technology provides an effective means of getting information quickly and directly to the people that need it.

Using the Center's Geographic Information System (GIS) and database resources, Data Management staff prepared maps of the locations of landfills, CERCLA sites and Surface Impoundments in the counties affected by the flood. The maps were used by county governments to identify flooded areas that may have disturbed sites of past contamination. The Historical Hazards GIS database was used by Federal Emergency Management Agency (FEMA) contractors to help them evaluation historic land use patterns of property under consideration for the relocation of the town of Valmeyer.

E. Educational Institutions

During FY'94, HWRIC received over 100 requests for assistance or for information from various educational institutions in Illinois. Publications from HWRIC's Clearinghouse were supplied to these institutions in response to requests. On several occasions, HWRIC staff made presentations at universities and secondary schools. (Presentations are listed in detail in Appendix A.) Staff also provided tours of the HWRIC facility to various student and teacher groups throughout the year. Examples of the types of assistance activities conducted with educational institutions in FY'94 are described below.

1. Influencing The Chemists of Tomorrow

The American Chemistry Society (ACS), through its county-wide sponsorship of National Chemistry Week, encourages the promotion of chemistry to the general public. HWRIC, in conjunction with State Water Survey and University of Illinois Chemistry Department personnel, under the auspices of the local ACS chapter, offered an open house on November 10 to chemistry and physics students and faculty from rural Champaign and Douglas county high schools.

This one-day open house, which was visited by over 150 students, teachers and chaperones, was held at the HML and offered a variety of displays, demonstration projects, experiments and general exposure to analytical instrumentation in the laboratories. Special displays of teaching tools and materials available to schools through the University of Illinois and other sources were set up for the teachers in HWRIC's library. Donations ranging from safety glasses to soft drinks were solicited from laboratory supply vendors and local businesses, and were offered to the open house participants. The effort was recognized by ACS when the Chapter received the prestigious Phoenix Award at the ACS conference for the best National Chemistry Week open house in the nation.

2. College and University Science Students Visit HWRIC

The Laboratory Services Program regularly provides tours of HWRIC's laboratory facilities for classes requesting such visits.

a. Parkland College Chemistry 101

Notable among those tours during the past year were those provided to first year chemistry students at Parkland Community College in Champaign. The tours and demonstrations were presented to approximately 100 students during both the Fall and Spring semesters.

b. UIUC Chemical Instrumentation Students

A working visit was provided to students in a nonmajors chemical instrumentation class from the University of Illinois. Approximately 50 students in this class were provided a facility tour that included opportunities to sit down with HWRIC chemists to learn how they apply various sample preparation techniques and instruments to the solution of real world analytical chemistry problems. This interchange was extremely well received by both the students and the LSP staff. The tours ended with an introduction to the many resources available in the Center's Library and Clearing-house.

3. Pollution Prevention in Curricula

One of the Center's ongoing goals is to promote the addition of P2 concepts in to existing higher education curricula. This approach helps to ensure that P2 concepts are understood and practiced by the next generation of engineers and managers.

a. MBA Integration

In July, HWRIC staff met with an Assistant Dean of the Graham School of Management at St. Xavier University in Chicago. The school is interested in expanding the environmental information in their curricula. This meeting was a brainstorming session on materials and focus for a pollution prevention course that would be part of the Master's of Business Administration (MBA) degree program. The School hopes to implement something within the next year or so, and they are planning to visit HWRIC and utilize our P2 information resources.

b. "Environmental Chemistry and Chemical Ecology"

This was the title of a mini-symposium sponsored by the Institute for Environmental Studies and held on the University of Illinois campus on August 26-27, 1993. Several HWRIC staff made the following presentations on recent work related to analysis of soil pollutants which would help those involved in both cleanup and prevention efforts: "Effects of Simple Organic Acid Anions and Municipal Landfill Leachate on the Electrophoretic Mobility of Calcite," and "Evaluation of Sequential Extraction Methods for Metal Speciation in Contaminated Soils Using Enriched Isotopes and Inductively Coupled Plasma-Mass Spectrometry." The symposium was well-attended, and included representatives from a variety of University departments, as well as from the scientific surveys and other organizations.

c. Pollution Prevention in Illinois State University Curricula

In December, four HWRIC staff members met with representatives from the departments of Industrial Technology, Accounting, and Health Sciences at Illinois State University to discuss ways in which pollution prevention concepts have already been and can be further integrated into existing curricula. Faculty were encouraged to apply for Center research funds to help them further develop P2 curricula materials.

3. University Curricula Development Projects

Two projects have been funded by HWRIC's Research Program to develop pollution prevention curricula for institutions of higher education. They are summarized below. Refer to Appendix C for more information on these and other projects.

a. "Pollution Prevention and Business Management"

This manual, written by Dr. Thomas Bierma and Frank Waterstraat of Illinois State University, consists of three instructional modules intended for use with higher level undergraduate as well as graduate level classes in business management.

b. "Pollution Prevention: A Course for Engineers"

This curricula package was developed and conducted in the Spring semester by Dr. Paul Anderson at the Illinois Institute of Technology. These curricula are in the review process and will be available for distribution in early winter.

4. University Class Lectures

In September, HWRIC's Assistant Director gave a lecture on "Toxics and Hazards" to UIUC Honors Program students. He also presented two lectures on P2 topics at the Illinois Institute of Technology, Wheaton campus and at Sangamon State University. The first lecture was entitled "Pollution Prevention Strategies for Illinois Business and Industry." The lecture was open to the public and about 50 people attended including several from area companies.

As a result, several companies have requested and received technical assistance and information. The second lecture was entitled "HWRIC's Technical Assistance Services and Illinois Pollution Prevention Case Studies." This presentation was given to a graduate P2 course in the Environmental Science Department with approximately 20 students in attendance.

5. Conferences and Presentations

a. Illinois Recycling Association Annual Conference on Household Hazardous Waste

A HWRIC staff member participated on a panel discussion concerning household hazardous waste. Information presented included: definition of household hazardous waste; currently available alternatives to products containing potentially hazardous waste; and, information on the resources of the Center.

b. DuPage County SCRAP Conference

On March 5th, two Pollution Prevention staff members gave separate presentations at the DuPage County School and School Recycling Assistance Program (SCRAP) Conference. The conference is a yearly event for educators in the DuPage County area to pick up new materials for use in their classrooms. HWRIC presentations included a participatory exercise dealing with Life Cycle Assessments and an informative talk on pollution prevention. Over 20 teachers attended each presentation.

6. Educational Publications

a. HWRIC Encourages Teachers to Participate in Earth Day

Children can play an important role in improving our environment, but they must be instructed on how and why it is necessary for them to be involved. For Earth Day 1994 (April 22), the Information Services Program compiled and sent information packets to approximately 33 schools in the area to assist teachers in getting this important message to students. The information included Earth Day events, easy Earth Day classroom ideas, recycling information, and brochures on other Earth Day resources. We asked teachers to stress to their students that everyone's contributions make a difference.

b. New Items Added to Clearinghouse

As part of the Earth Day effort, two new items were added to the Education section of the Clearinghouse: "Earth Day Ideas" (SCH-010), compiled by HWRIC's Information Assistant, and "In the Battle Against Pollution...YOU Can Make a Difference," (SCH-011) which originally appeared in the *USEPA Journal*, and for which we obtained distribution permission.

Several other items added to the household hazardous waste section of HWRIC's Clearinghouse are geared toward homeowners and parents, including three public health brochures about removing lead-containing products from homes.

7. Other Outreach Efforts

a. Higher Education

The interactions between HWRIC and the University of Illinois have been steadily increasing. HWRIC's Director has participated in two long-range planning efforts at the University of Illinois. These include participating in a work group addressing the service mission of UIUC, and as a member of the Task Force on the Environment. Both efforts have allowed HWRIC and the Scientific Surveys to become more integrated into future university efforts and programs.

In addition, a mailing was sent to all community colleges asking for information on their pre-engineering, business and public health departments for future use in marketing curricula developed through HWRIC's Research Program and to serve as information source.

8. Brown Bag Seminars

Through its Brown Bag Seminar program, HWRIC furthers the education of its staff by inviting speakers in a variety of topical areas. These seminars are advertised campus-wide and all are welcome to attend.

a. Baxter Healthcare

On October 12, 1993, Rob Currie from Baxter Healthcare discussed pollution prevention efforts at Baxter, the world's largest supplier of health care supplies. Currie is one of the company's pollution prevention specialists. He serves on the Advisory Committee for HWRIC's regional P2 information resources project. Baxter staff believe pollution prevention programs are necessary for three reasons: to avoid bad publicity; to avoid costly cleanup; and, to do the right thing. Baxter emphasizes reduction of air toxics, hazardous waste, solid waste, and packaging. Currie cited the following as successful elements of P2 programs:

- Senior management commitment
- Training/awareness
- Waste generator pays
- Quality principles (TQM-total quality management)
- Measurement/tracking
- Empowerment/total employee involvement, and
- Quality action teams.

b. Arsenic-Contaminated Wastewater

On October 20, Drs. Robert Fuessle and Max Taylor from Bradley University presented a seminar on their HWRIC-sponsored project "Stabilization of Arsenic Nonwastewaters." The goals of the project have been to identify an effective arsenic stabilization design and to identify the characteristics of those arsenic wastes that are amenable to stabilization.

The investigators have obtained samples from PDC Laboratories in Peoria, which receives wastes from a variety of sites. One industrial process that yields arsenic-containing wastewater is glass manufacturing. Results from this project could aid glass manufacturers in waste management.

c. Treatment of Contaminated Soils

On October 27, Dr. Joseph FitzPatrick and Mr. Stan Zagula from Northwestern University presented an annual review seminar on their HWRIC-sponsored project "An Investigation of Column Flotation Technologies for the Pretreatment and Volume Reduction of Contaminated Soils and Sediments." The investigators postulate that pretreating contaminated soils and sediments prior to standard soil washing will significantly reduce the total volume of the materials requiring washing, thus making the soil washing a less costly process, and potentially yielding an overall cost savings in total treatment of contaminated soils and sediments. The seminar presentation was followed by a working meeting to discuss analytical work being conducted at the Center's Hazardous Materials Laboratory in support of the project.

d. Wetlands Seminar

On March 21, Scott Simon, Assistant Research Biologist of the Illinois Natural History Survey, spoke on wetland restoration as part of the Brown Bag Series. Defining wetlands, the process of restoring wetlands and the benefits of wetlands to the state and the environment were discussed.

Chapter IV: Collaborative Efforts

A. Introduction

A key strategy to effectively and efficiently reach a larger audience is to work collaboratively with other agencies and organizations. Organizations HWRIC collaborates with include local, state and federal government agencies, colleges and universities, and business associations. This collaboration allows our small staff to reach a greater number of the over 200,000 businesses and other organizations in Illinois that have environmental concerns.

While direct assistance is given as much as possible, information about HWRIC's services, and about waste management and sound environmental strategies, is provided through direct mailing of reports and other information materials, speeches at professional meetings, sponsored conferences, and referrals from industrial associations. The Center's laboratory facilities are specifically designed for collaborative projects including technology development, testing, and analytical support of research.

Highlights of collaborative efforts undertaken by HWRIC in FY'94 are described in this chapter by geographic areas of the state and in terms of those efforts more broadly applicable to the Great Lakes Region. By working with other organizations, especially business associations, our intent is to reach generators that might not come to us directly. Many of these activities are described in more detail in other chapters of this annual report.

A key strategy to effectively and efficiently reach a larger audience and to better carry out the Center's mandates is to work collaboratively with other organizations.

B. Chicago Area Projects

In the Chicago area, HWRIC is collaborating primarily with industrial associations, various government agencies, and the newly established Chicago Manufacturing Center (CMC).

In the Fox River valley area west of Chicago, HWRIC has collaborated with the Valley Industrial Association (VIA). Three VIA member companies were funded by a grant from the Illinois Technology Challenge Fund to draw upon HWRIC's services to help solve their most pressing environmental problems. HWRIC also worked with two other VIA members.

In the fall of 1993, USEPA Region V awarded HWRIC a two-year grant to undertake a cooperative project with the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC), the City of Chicago, IEPA and USEPA. The primary purpose of the project is to provide environmental technical assistance to industry in the Chicago area. This funding was used to hire a technical assistance engineer located

HWRIC was awarded a contract from USEPA Region V under the Pollution Prevention Incentives for States (PPIS) competitive grants program to assist companies in Southeast Chicago and in East St. Louis reduce the use of ozone-forming solvents. Target companies are those that clean metal parts.

in the MWRDGC offices. Initially, a series of workshops were provided to train inspectors and permit writers from the District and the other participating regulatory agencies in key concepts of pollution prevention. This was followed by a public workshop for environmental consultants and industry on how to incorporate pollution prevention into business practices. Through various publicity efforts and referrals from District staff, approximately 15 companies were given on-site assistance during the first nine months of the project.

Also in the fall of 1993, HWRIC was awarded a contract from USEPA Region V under their Pollution Prevention Incentives for States (PPIS) competitive grants program to assist companies in Southeast Chicago and the American Bottomlands area around East St. Louis. The purpose of this project is to help companies that clean metal parts reduce the use of ozone-forming solvents. Outreach to industry to promote this testing service is being done in collaboration with the Small Business Energy and Environment Program of the Illinois Department of Commerce and Community Affairs (DCCA).

A new project, funded by USEPA, was awarded to the University of Michigan and the University of Illinois, Urbana-Champaign (UIUC) in partnership with HWRIC. The goal of this project is to develop a pilot environmental assistance network through cooperative extension services. This Environmental Extension Network (EEN) is being initially tested in Southeast Chicago. The Center is providing introductory training to the EEN project staff on pollution prevention and environmental regulations. Initially, this project will focus on providing assistance to dry cleaners and automotive service businesses with hazardous waste compliance issues. HWRIC staff will provide technical support for these efforts.

In June, 1994, DCCA awarded a related contract to HWRIC and the EEN project team. The purpose of this project is to provide pollution prevention and environmental assistance to all manufacturers in Southeast Chicago. This is one of seven projects funded under the state's Coalition for Manufacturing Performance Through Technology (COMPETE) program from the Technology Challenge Fund. The goal of COMPETE is to help Illinois manufacturers modernize and improve productivity. In both projects, EEN staff will develop informational materials and promote available services directly to businesses and citizens in the area. HWRIC will provide technical information, on-site evaluations of regulatory problems, and will identify pollution prevention opportunities.

A major collaborative effort in the Chicago area is a partnership HWRIC has formed with the Chicago Manufacturing Center (CMC). The CMC is a not-for-profit corporation funded in part by the National Institute of Standards and Technology (NIST), a division of the U.S. Department of Commerce. The goal of the CMC is to help small to medium-sized manufacturing companies upgrade their equipment, improve their processes, and strengthen their business performance. HWRIC will assist the CMC in evaluating environmental concerns of businesses requesting assistance and will work to integrate pollution prevention considerations into business modernization projects.

With state funding in FY'95 and contract funding from the CMC, HWRIC will establish an office co-located with the CMC at Homan Square in Chicago's North Lawndale community. HWRIC was honored to be included in the official opening ceremonies of the Chicago Manufacturing Center this summer. HWRIC's Director and Pollution Prevention Program Manager attended the event, which featured U.S. Secretary of Commerce Ronald Brown.



FIGURE 4-1: OPENING CEREMONIES FOR THE CHICAGO MANUFACTURING CENTER (CMC).

LEFT TO RIGHT: RHEAL TURCOTTE, CMC PRESIDENT; RICHARD M. DALEY, MAYOR OF CHICAGO; RONALD H. BROWN, U.S. SECRETARY OF COMMERCE; EDWARD J. NOLIA, CHAIRMAN, CHICAGO ECONOMIC DEVELOPMENT COMMISSION; JAN GRAYSON, DIRECTOR, IL DEPT. OF COMMERCE AND COMMUNITY AFFAIRS.

HWRIC laboratory staff have been working with UIUC undergraduate engineering students to conduct air quality sampling at Armstrong World Industries' (a tiling and flooring specialist) Bourbonnais facility. The lab staff have trained the students in sampling techniques and have provided analysis of the volatile compounds found in the samples collected during the first two phases of a three phase sampling plan. The effort is aimed at defining air quality problems at the facility, with the goal of implementing pollution prevention or other corrective measures.

HWRIC's chemists worked with faculty from the UIUC School of Veterinary Science on a project involving aquarium tank water from Chicago's Shedd Aquarium. After a fish kill in one of the Aquarium's tanks, Shedd officials suspected sabotage, and contacted the Veterinary School for analytical assistance. The School contacted HWRIC to apply the capabilities of the Center's mass spectrometer to analyze the water samples for the presence of the suspected toxic chemicals. The analysis showed the presence of low levels of cleaning chemicals.

In another chemical analysis project, Laboratory staff worked with the UIUC Forestry Department to assist Argonne National Laboratory scientists to help develop new ways to delineate contaminated groundwaters. The project involved development of methods to prepare and analyze various tree and plant tissues for the presence of chlorinated hydrocarbons such as carbon tetrachloride.

The research effort seeks to apply techniques by which tissue samples from trees growing over relatively shallow groundwater can be used to screen for contamination, thereby minimizing the need to drill expensive wells.

C. Great Lakes Regional Projects

HWRIC's analytical instruments, particularly the inductively coupled plasma/mass spectrometer (ICP/MS), are being used to measure low levels of 14 metals commonly found in rainfall. These analyses are in support of a study of Great Lakes region toxic air contaminants. USEPA is contracting with the State Water Survey to operate the sample collection network of contaminant monitoring stations. HWRIC is helping to provide the analytical results on the collected samples.

Over the past year, HWRIC has participated in a regional study called the Great Printers Project, led by the Council of Great Lakes Governors, the Environmental Defense Fund, and the Printing Industry of America. Two primary goals of the project are to:

- Motivate and enable printers in the Great Lakes region to adopt pollution prevention strategies, and
- Recast the approach of government environmental policies, regulations and practices to more efficiently serve printers and include a prevention focus.

HWRIC was primarily involved in developing strategies for improving technical assistance services for the printing industry. Following publication of the final project report, HWRIC has helped to initiate a pilot project to begin implementing the recommendations that followed from the Great Printers Project.

The results of HWRIC's survey and analysis project indicate that pollution prevention information needs identified in the region could be best met by establishing a Great Lakes regional information sharing network.

With funding from the Great Lakes Protection Fund, a planning study was undertaken by HWRIC to evaluate the status of pollution prevention information resources and needs in the region and recommend strategies to better meet those needs. An advisory group was convened from representatives throughout the Great Lakes region to help guide the study. A directory, entitled *Great Lakes Pollution Prevention Information Resources Catalog*, was published as one result of this project. The major recommendation resulting from this study is that pollution prevention needs identified in the region could be best met by establishing a Great Lakes regional information sharing network. The final report, *Great Lakes Pollution Prevention Information Resources: Current Status and Future Recommendations*, discusses the project survey as well as the recommendations for future cooperation and collaboration in providing necessary information to industry.

For the past five years, HWRIC has actively participated in the Midwest Pollution Prevention Roundtable, which is comprised of representatives from pollution prevention organizations, and which meets twice yearly. The purpose of these meetings is to develop cooperative projects, share information resources, and identify effective methods for promoting pollution prevention. During the past year, HWRIC staff assisted this organization by publishing a regional newsletter, *LINK*, and helping to establish a charter for the Roundtable.

The charter, adopted in the summer of 1994, changed the name of the organization to the Great Lakes Regional Pollution Prevention Roundtable and formalized some of the organization's topical workgroups. HWRIC's efforts to support the Roundtable have been to facilitate information sharing and to develop improved methods of providing technical assistance to businesses. Through these meetings, collaborative activities are being explored with the Clean Air Act small business assistance programs in each of the USEPA Region V states.

In addition, the Center has collected important pollution prevention information from elsewhere in the Great Lakes region, and then made it available to Illinois businesses via our technical assistance and information outreach efforts.

D. Central Illinois Projects

The American Foundrymen's Society and the Illinois Cast Metals Association cooperated with HWRIC on a study of pollution prevention practices in foundries. This study was funded by USEPA with the objective of identifying nonhazardous industrial wastestreams that could be reduced through more widespread implementation of pollution prevention technologies. The industry groups assisted by identifying three central Illinois foundries willing to participate in the study. In addition, the trade groups provided valuable review comments on the final project report.

Small businesses in Peoria and Tazewell counties are the focus of technical assistance efforts in another USEPA-funded project. The purpose of this project is to help businesses reduce the volume of wastes they generate that may be going to shallow, uncontrolled wells (known as Class V wells). These wells, including septic tanks, floor drains and even drainage ditches, can contaminate groundwaters used for drinking water supplies. The geology in those two counties is particularly susceptible to contamination from these types of wells. Cooperating with HWRIC on this project are: the City of Pekin; the Central Regional Groundwater Protection Planning Committee; and the Pekin Groundwater Protection Committee.

E. Southern Illinois/American Bottomlands Area Projects

The Illinois Department of Public Health (DPH) has contracted with HWRIC to provide analytical assistance and technical guidance on a study of lead levels in the East St. Louis area. The study, funded by USEPA, will examine blood lead levels of residents and correlate them with levels found in their neighborhoods. HWRIC analysis will focus on the contaminants lead, cadmium, and arsenic in area air, household dust, yard soil, and drinking water samples taken at the residences of those whose blood lead levels are being measured.

Three central Illinois foundries participated in a project to identify nonhazardous wastestreams that could be reduced by pollution prevention efforts.

We have provided analytical services and technical guidance for a number of research projects with UIUC researchers involving contaminants in southern Illinois. These studies entailed measurements of: lead levels in soils and rat diets; pesticides in soils from agricultural sites; and polychlorinated biphenyls (PCBs) in soil and air samples from Crab Orchard National Wildlife Refuge.

The other main project undertaken to address environmental problems in this area of the state is the solvent alternatives project (PPIS) mentioned above that targets companies in East St. Louis and in Southeast Chicago.

F. Summary

Many collaborative activities undertaken in FY'94 were with state and federal government agencies. These are listed in Table 4-1.

TABLE 4-1: HWRIC COLLABORATION WITH OTHER GOVERNMENT AGENCIES

COLLABORATIVE PROJECTS WITH GOVERNMENT AGENCIES IN FY'94
Greater Chicago Pollution Prevention Project Solvent Alternatives Project -- Southeast Chicago and American Bottomlands
Environmental Extension Network (EEN) with the University of Illinois
State Water Survey study of air toxics in the Great Lakes
Great Printers Project with the Council of Great Lakes Governors, the Environmental Defense Fund and the Printing Industry of America
"Regional Pollution Prevention Information Resources: A Planning Study" funded by the Great Lakes Protection Fund (created by the Council of Great Lakes Governors)
Great Lakes Regional Pollution Prevention Roundtable participation (many members from state and provincial government agencies)
Department of Public Health study on levels of lead contamination in East St. Louis

Local government agencies are involved in the Class V well pollution prevention project in Peoria and Tazewell counties. In the Greater Chicago Project, both the City of Chicago and the Metropolitan Water Reclamation District of Greater Chicago are major participants.

In addition, IEPA and DCCA were cosponsors with HWRIC of a statewide teleconference on spray painting pollution prevention alternatives. HWRIC staff made several presentations at the annual Illinois Pollution Prevention Conference that was sponsored by IEPA.

The primary business associations that HWRIC worked with during the past year were the Valley Industrial Association, the American Foundrymen's Society, the Illinois Cast Metals Association, and the Chicago Manufacturing Center. Publicity about Center activities and sponsored events was provided by the Illinois Manufacturers Association, the State Chamber of Commerce, the Chemical Industry Council, the Consulting Engineers Association of Illinois, and the Access Illinois electronic bulletin board system.

Besides funding research studies with several universities in Illinois, collaborative projects were undertaken with Northwestern University and several units of the University of Illinois including the Cooperative Extension Service, the School of Horticulture, the College of Engineering, the School of Veterinary Science, and the Forestry Department.

HWRIC will continue to look for ways of better providing pollution prevention, waste management and other environmentally related information to the businesses and citizens of the state by working collaboratively with others. It is by working through a diverse network of organizations that we are able to reach the many people and businesses that could benefit from our services.

Chapter V: Research Directions

A. Introduction

Illinois is one of only a few states in the nation that provides funding for research to investigate the nature and extent of environmental contaminant problems and the means to correct them. While the majority of state funding must be spent for remediation of sites of past contamination, research can better define our technology needs and provide new, less expensive technologies to hasten the restoration of contaminated sites, to remove the contaminants more completely, and to reduce the probability of future contamination. The Hazardous Waste Research Fund (HWRF), which is generated primarily by tipping and hauling fees for hazardous waste disposal, is the largest source of state funding for the Center's Research Program. The Research Program in turn funds basic and applied research projects on hazardous waste and pollution prevention topics. Projects are selected through the annual competitive process discussed in Chapter 2.

Technology development and testing is one part of HWRIC's Research Program. Other research efforts include collection of data to characterize a particular site or a wastestream; examination of the use of natural and augmented biological remediation of contaminated areas; evaluation of the health risks posed by existing contamination and the remediation efforts selected to restore these areas to their original state; and development of curricula that encourage the next generation of engineers, scientists, and managers to incorporate environmental impacts into their business decisions. While finding new and better ways of correcting the environmental problems that exist in Illinois must continue to be one of the Center's goals, preventing future problems and maintaining or even improving the quality of the environment has become the focus of both HWRIC's sponsored and conducted research efforts.

The costs of scientific investigations continue to increase, while state support for the Center's Research Program has remained relatively constant over the last two years. One means of supplementing our fiscal base for projects has been for HWRIC Research Program staff to work with other state and federal agencies, industries, and other funding sources to identify projects of mutual interest and share the funding. This fiscal cooperation has enabled both HWRIC and the cosponsoring groups to fund a greater number of, and more expensive, investigations, such as field evaluations, than would have ordinarily been possible.

Scientific studies conducted by HWRIC staff and supported primarily by federal funding have increased significantly. Center staff were awarded contracts to pursue a variety of research topics, most of which have as a central theme finding practical and implementable solutions to better manage and reduce industrial wastestreams. Many of these projects are cooperative efforts between Center staff and other state, federal, and municipal agencies or organizations, and are geared toward expanding

Illinois is one of only a few states in the nation that provides funding for research to investigate the nature and extent of environmental contaminant problems and the means to correct them.

Scientific studies conducted by Center staff and supported primarily by federal funding have increased significantly. Most contracts awarded Center staff have as a theme finding practical solutions to better manage or reduce industry wastestreams.

the technical assistance capabilities HWRIC provides. All of these investigations help HWRIC staff learn more about the needs of Illinois' industries and how to better address them.

State funding of \$762,400 provided support for 26 projects during FY'94. Several of these studies were begun in FY'93 or earlier. Nine new projects were initiated in FY'94.

The previous chapters have presented an overview of all of HWRIC's programs and more detailed descriptions of the technical assistance activities and collaborative efforts. In this chapter, the discussion centers on the research conducted by Center staff as well as the projects conducted by investigators funded through HWRIC's Research Program.

B. Center-Funded Projects

State funding of \$762,400 provided support for 26 projects during FY'94. Several of these studies were begun in FY'93 or earlier. Nine new projects were initiated in FY'94. All of the Center-funded research projects were selected from preproposals and proposals submitted in response to HWRIC's annual solicitations (see Chapter 2). Eleven of the FY'94 projects are now completed. Final project reports have been received and are either already available, in final review, or being revised for publication. These studies are listed in Table 5-1, which also includes the publication number for the report or the anticipated date of publication. The remaining 15 FY'94 projects continue into FY'95 (Table 5-2).

TABLE 5-1: COMPLETED RESEARCH PROJECTS IN FY'94

Title	P.I.\ Affiliation	Date Report Available
Measurements of Indoor Toxic VOC Concentrations Attributed to the Residential Storage of Household Hazardous Waste	Sweet & Vermette/ Illinois State Water Survey Buffalo State	Winter 1994
An Investigation of Column Flotation Technologies for the Pretreatment and Volume Reduction of Fine Contaminated Soils and Sediments	FitzPatrick/Northwestern University	Spring 1995
LUST Cleanup Technology Report	Wolterink/ Perino Technical Services Inc.	Winter 1995
Treatment of Spent Chemical Oxygen Demand Solutions for Safe Disposal	Holm/ Illinois State Water Survey	Spring 1995
Development of an Environmentally Safe Conversion Coating System for Magnesium	Briles/ Sunstrand Aerospace	Winter 1994
Stabilization of Arsenic Nonwastewaters	Fuessle & Taylor/ Bradley University	Fall 1994
Course in Pollution Prevention	Anderson/ Illinois Institute of Technology	Winter 1994
Development and Pilot Demonstration of a Computerized Bar-Code Based Waste Tracking System for Waste Minimization at Argonne National Laboratory	Peters/ Argonne National Laboratory	Spring 1995
Pollution Prevention and Business Management Curricula for Schools of Business and Public Health	Bierma/ Illinois State University	Winter 1994
An Analysis of Municipal Solid Waste Reduction Opportunities in Industrial/Commercial Distribution Networks	Snyder/ Community Recycling Center - Champaign	Winter 1994
Pollution Prevention for Chemical Processes: A Handbook with Solved Problems from the Refining and Chemical Processing Industries	Allen & Rossetol/ University of California, Los Angeles	TR-022 September 1994

TABLE 5-2: CONTINUING RESEARCH PROJECTS

Title	P.I./ Affiliation	Project Duration (Years)	Project End Date
Waste Management Options			
Effect of Chemical Immersion on Interface Strengths of Hazardous Waste Landfill Liner Systems	Stark/ University of Illinois @ Urbana-Champaign	2	9/95
Impact of Fly Ash Disposal on Plant Development	Rayburn/ University of Illinois @ Urbana-Champaign	3.75	9/95
Remediation Technologies			
Identifying Site Specific Limitations to Successful In-Situ Bioremediation of Agrichemical Retail Sites	Cole/ University of Illinois @ Urbana-Champaign	2	12/94
Toxic Heavy Metals in Biodegradation and Bioremediation Technologies	Niederhoffer/ Southern Illinois University @ Carbondale	2	10/95
Enhancement of BTEX Biodegradation Rates Under Iron-Reducing Conditions	Kelly/ Illinois State Water Survey	1.3	9/96
Air Sparging Investigation at Mattison Machine Works, Rockford, IL	Davis/ Fehr-Graham & Associates	1.25	9/95
Pollution Prevention Technologies/Techniques			
Product and Process Design Tradeoffs for Pollution Prevention	Thurston/ University of Illinois @ Urbana-Champaign	1.1	6/95
Field Testing of In-Situ Phosphatizing Coatings	Lin/ Northern Illinois University @ DeKalb	1.8	6/95
Waste Management Survey of Illinois Higher Education Institutions	O'Rourke/ Survey Research Laboratory	3.5	6/95

TABLE 5-2: CONTINUED

Title	P.I./ Affiliation	Project Duration (Years)	Project End Date
Technology Transfer to Aid Pollution Prevention and Waste Management	Gwiasda/ Survey Research Laboratory	2	6/95
Overcoming Barriers to Pollution Prevention in Small and Mid-Size Illinois Manufacturers	Bierma/ Illinois State University @ Normal	1.5	12/94
Development of an Activated Carbon Fiber Adsorption/Regeneration System to Recover and Reuse Toxic Organic Compounds	Rood & Larson University of Illinois @ Urbana-Champaign	2	10/95
Risk Assessment			
Starlings as Avian Models and Monitors of Remedial Effects at Crab Orchard National Wildlife Refuge	Halbrook/ Southern Illinois University @ Carbondale	2.1	6/96
Determination of Animal Hazards from Air and Soil Samples from Crab Orchard	Hansen/ University of Illinois @ Urbana-Champaign	3	6/95
Household Pets as Sentinels of Lead Exposure Phase II: A Study of Lead Exposure	Buck/ University of Illinois @ Urbana-Champaign	4	6/95

Although researchers are encouraged to make presentations and to submit articles for publication in the peer-reviewed literature about their HWRIC-sponsored research, these two ways of publicizing the work tend to present an overview of an effort rather than a detailed account. HWRIC expects documentation of projects from the researchers it funds. Also required is a final project report that describes the investigation and includes: background information about the problem being studied; a detailed description of the project, its successes and failures; and the conclusions with supporting data. The final project report must be submitted before the end of the project, but frequently editorial, technical, and final reviews continue after the project end date.

Nine research reports were completed and printed during this fiscal year (Table 5-3). Also included in this table are three project reports prepared by Center staff to describe their externally funded projects and present the conclusions of these studies (TR-012,-013,-014).

FY'94 Center-funded researchers come from state and private universities, the State Water Survey, consulting engineering firms, industry, a federal laboratory, and a recycling operation. The FY'94 projects can be grouped into four general categories: waste management options, remediation technologies, pollution prevention technologies/techniques, and risk assessment. Brief summaries of all of the FY'94 projects are provided as Appendix C of this annual report. Four of the projects completed in FY'94 are highlighted on the following pages.

1. Leaking Underground Storage Tanks (LUSTs) Remediation

Underground storage tanks are used to store a variety of liquids, but most frequently are used for the storage of fuel. This type of tank can be found everywhere from the corner gas station to a remote vacation cabin. It is believed that there are nearly two million underground storage tanks in the U.S. used to hold fuel to heat homes, farms, schools, and other buildings.

National estimates indicate approximately 25% of all underground storage tanks are currently leaking contaminants into the environment. In most cases the contaminant is a petroleum hydrocarbon such as gasoline, diesel fuel, aviation fuel, kerosene, used motor oil, or fuel oil. The release of these compounds from a LUST results in contamination of the surrounding soil and frequently of the underlying groundwater as well. The contamination may be in the form of liquid petroleum products in the soil or floating on the groundwater, adsorbed hydrocarbon on the soils, or dissolved contaminants in the water. Because of the potential impact that these uncontrolled releases may have on the nation's groundwater resources, regulations have been passed that require monitoring

Published documents — reports, factsheets, etc. — on most of the research projects undertaken by and for the Center are available at little or no charge from the Clearinghouse.



FIGURE 5-1: REMOVING AN UNDERGROUND STORAGE TANK

TABLE 5-3: FY'94 PUBLISHED REPORTS AND DOCUMENTS

Report Number Title	Author(s)	Publication Date
RR-064 Field Study of Transit Time of Water and Tracers Through a Soil Liner	Keros Cartwright, Ivan Krapac, Samuel Panno, Bruce Hensel, Illinois State Geological Survey Kenneth Rehfeldt, Illinois Water Survey	July 1993
RR-065 LUST Remediation Technologies Part 2: Soil Corrective Action Description	Perino Technical Services Springfield, Illinois	August 1993
RR-066 Speciation and Mobilization of Toxic Heavy Metal Ions by Methanogenic Bacteria	Mark Foster, T. Conver, Allyson Rodabough, Tressia Dayton, John Koropchak, Eric Niederhoffer Southern Illinois University	October 1993
RR-067 Evaluation of Fe Oxide-Coated Granular Activated Carbon for Removal and Recovery of Cu(II) and Cr(VI) from Aqueous Solutions	T.C. Wang, K.P. Chandra, Paul Anderson Illinois Institute of Technology	April 1994
RR-068 Demonstration of Hydraulic Fracturing to Facilitate Remediation	Larry Murdoch, Mark Kemper, Mohan Narayanaswamy, Allen Wolf University of Cincinnati	April 1994
RR-069 Household Pets as Monitors of Lead Exposure to Humans	William Buck, Louise-Marie Côté, Philippe Berny University of Illinois	June 1994
TR-012 Ink and Cleaner Waste Reduction Evaluation for Flexographic Printers	Gary Miller, William Tancig, Hazardous Waste Research & Information Center, Michael Plewa, University of Illinois, Institute for Environmental Studies	January 1994
TR-013 Recycling Nickel Electroplating Rinse Waters by Low Temperature Evaporation and Reverse Osmosis	Timothy Lindsey, Jacqueline Peden, Hazardous Waste Research and Information Center	January 1994
TR-014 Evaluation of Ultrafiltration to Recover Aqueous Iron Phosphatizing/Degreasing Bath	Timothy Lindsey, Alisa Ocker, Gary Miller, Michelle Miller, Hazardous Waste Research and Information Center	January 1994
TR-016 Waste Management Study of Foundries Major Waste Streams, Phase II	Marvin McKinley, Irvin Jefcoat, William Herz, Christopher Frederick University of Arizona and American Foundrymen's Society	April 1994
TR-017 Improved Quantitation of Organic and Inorganic Carbon in Soils and Aquifer Materials	Michael Caughey, Illinois State Water Survey, Michael Barcelona, Western Michigan University	April 1994
TR-019 Use of Landfarming to Remediate Soil Contaminated by Pesticides	Andrews Environmental Engineering Springfield, Illinois	June 1994

systems for new underground tanks, inspections of existing underground tanks, and immediate corrective actions when leaks are found.

In FY'93, HWRIC funded Perino Technical Services, Inc. to develop a guide that would provide information on the technologies being used for the cleanup of both soils and groundwater contaminated by LUSTs. Their study has resulted in a three-part report. Part 1 presents a summary of technology options for soil corrective actions. An in-depth description of each of the technologies is provided in Part 2.

The final volume, Part 3, discusses the technologies available for groundwater cleanup. Regulatory information about the corrective action requirements, and for each specific technology, is included in the report. The technologies discussed in the reports have all been used to remediate LUST sites, but not necessarily sites in Illinois. However, the technologies have been labeled acceptable by IEPA for use in the state.

For each technology, the report contains a complete description of the process, engineering design parameters, and costs. The soil technology options include: removal, transport, and landfill disposal; soil vapor extraction; bioremediation; thermal treatment and incineration; soil washing; *in situ* soil flushing; solvent extraction; chemical dechlorination; and *in situ* vitrification. The water technology options are: recovery of liquid petroleum hydrocarbons, conventional pump and treat (including: air stripping, activated carbon adsorption, chemical oxidation, ultra violet oxidation, biological treatment, chemical precipitation and flocculation/aggregation, ion exchange, and reverse osmosis), *in situ* bioremediation, aquifer air sparging, and vacuum vaporization. As with the soil options, each technology is described, engineering parameters are defined, and costs are provided whenever possible. In Illinois, the researchers found that most of the LUST contaminated soils continue to be excavated and landfilled while pump and treat technologies are used on the contaminated groundwater. All three volumes are, or will be, available from HWRIC's Clearinghouse.

The Center provided funding to Perino Technical Services for development of a guide on technologies to use for the cleanup of soils and groundwaters contaminated by leaking underground storage tanks.

2. Pollution Prevention for Chemical Processes

Refining and chemical process industries are responsible for nearly half of the releases and transfers reported in the Toxic Chemical Release Inventory (TRI) in the state of Illinois. Additionally, 24% of the Illinois facilities that must complete TRI reports belong to this industry group. To encourage reductions in releases from this industry group, the Center funded Dr. David Allen and Ms. Kirsten Rosselot of UCLA to develop a manual that would present pollution prevention options for the refining and chemical process industries in Illinois. These researchers were selected for this study because they had already developed materials for a related workshop they conducted in 1992. It was designed to introduce pollution prevention concepts to USEPA permit writers for this industry group.

The handbook that they developed in this study, entitled *Pollution Prevention for Chemical Processes: A Handbook with Solved Problems from the Refining and Chemical Processing Industries*, is designed for use in short courses, training sessions, and as a supplementary text in university engineering design courses.

The P2 handbook for chemical processing describes the basic structure of a pollution prevention program and how to implement one. The handbook, which can be used in university courses, includes pollution problems and possible solutions.

The handbook describes the basic structure of a pollution prevention program and how it can be implemented. It shows ways in which the volume and/or toxicity of wastestreams can be reduced through chemical substitution, improved operations, and process modifications.

The handbook topics are presented in the context of unit operations, an approach that relies on an understanding of pollution prevention concepts and general industrial processes. It compares total cost assessment with the costs of current disposal practices to illustrate the potential economic benefits of pollution prevention. Case studies that compare pollution prevention to end-of-pipe methods for controlling wastes are also presented. Questions/problems are posed to both technical and nontechnical readers and at least one possible solution for each problem is discussed. Although the handbook contains Illinois-specific information, much of what it contains is relevant to the chemical industry nationwide. The handbook can be obtained from HWRIC's Clearinghouse by requesting report HWRIC TR-022.

3. Solid Waste Reduction Opportunities in Industrial/Commercial Distribution Networks

Manufacturing and distribution facilities generate large quantities of nonhazardous packaging material, such as pallets, stretch film, plastic strapping and corrugated cardboard. The packaging is designed to protect the product during transport and then is processed through the manufacturing/distribution/retail network. The goal of this study was to identify techniques to reduce, reuse, or recycle that packaging.

Researchers from Champaign's Community Recycling Center found that three materials were predominant in this waste — corrugated cardboard, pallet stretch film plastic, and wooden pallets and crates. Most distribution centers break down their pallet loads into smaller packages for the retailer, but for those centers that do not, waste volume "spikes" consisting of outdated, off-specification, and discontinued products, are a problem. It is the decision of the wholesaler and the distributor whether to use bulk versus single use packaging. They must also decide if the product must be repackaged before being sent to the retail outlet. The choices of single use packaging and repackaging can result in significant increases in the volume of packaging wastes that is finally disposed. Distributors can, however, have a positive effect through the use of returnable containers, take-back programs, and centralized recycling programs.

Recycling of distribution waste at facilities in Illinois was found to be a function of the location and size of the distribution centers. Large distributors in metropolitan areas of the state typically recycle cardboard and most of the plastic film. Opportunities to reuse good pallets and rebuild or grind damaged pallets also exist in the large cities. Recycling options are not as readily available in small towns.

The use of reusable and low waste packaging is relatively uncommon in Illinois. This is largely due to the problems associated with the return of the container to the distributor, particularly storage and transport of the empty returnable container by the retailer to the distributor.

Again, more opportunities exist in the large metropolitan areas. As delivery distances increase, so does a trucker's desire to fill the cargo space with new product rather than reusable materials for the return trip. Incentives to recover and reuse these wastes are available, but the distributors and the public must be told about them. The researchers suggest state government fill this information gap by serving as a clearinghouse for information on waste reduction options and by aggressively marketing the state's industrial waste exchange. The final project report for this work will be available in the winter of 1994.

4. Risks from Storage of Household Hazardous Products

Many toxic chemicals are taken into the human body through inhalation. Poor indoor air quality is often attributable to the products and materials used in residential and commercial buildings. Chemicals released from these materials into the air may be present in high concentrations. The fact that Americans spend nearly 90% of their days indoors further increases their health risks by compounding the effects of high contaminant levels with prolonged exposure. In households, the storage of new or leftover household products, such as automotive products, paints, solvents, and other cleaners, may contribute to the deterioration of indoor air quality. This study was designed to document the types and amounts of toxic materials found in the home as the result of the storage of common household products.

The researchers in this study used a test house that simulated the typical pattern of storage in a garage or attached cabinet external to the living areas. The test house allowed the researchers to control the flow of air through the various rooms of the structure and to see how the concentrations of the chemicals being monitored changed as they passed through the living areas. High concentrations of the volatile products were found in the storage areas, with the peak concentrations generally occurring within 24 hours of the product being placed in storage. Concentrations in the living area were generally about half that of the storage area. In both areas concentrations slowly declined with time.

The second phase of the study looked at the same chemicals (including benzene, carbon tetrachloride, toluene, freon, and trichloroethane) but measured them in actual residences. The amount of these target chemicals was again higher in the storage area than in the living spaces. In general, however, the actual concentrations of chemicals in the homes were considerably less than in the test facility, probably because of the dilution of the compounds through natural ventilation. Air samples from the homes did have more single compound spikes (mainly chloroform and perchloroethene), but these elevated levels still did not approach those found in the test facility. These spikes probably resulted from the introduction of fresh sources of the chemical, such as dry-cleaned clothes, into the living area.

It was concluded that household products stored in attached storage areas can cause significant elevations in the levels of toxic compounds in the air; however, normal air flow generally dilutes these levels quickly. The report for this study is currently being revised to address the comments of the reviewers. It should be available from HWRIC in the winter of 1994.

Incentives to recover and reuse packaging materials are available, but the distributors and the public must be told about them. Researchers have suggested state government fill this information gap.

The fact that Americans spend nearly 90% of each day indoors further increases their health risks from exposure to toxic chemicals.

C. Center-Conducted Projects

While some projects HWRIC has undertaken with outside funding fit the more standard description of a research project that seeks to answer one or more basic scientific questions, most are nontraditional and seek very applied answers to a company's or facility's immediate waste management needs. During FY'94, ten Center-conducted studies received financial support from federal and regional organizations. These projects are listed in Table 5-4, which includes the name of at least one participating partner for each project. The degree of partnership varies considerably among the different projects. In some instances, the project was truly a joint agency/organization effort with all of the participants listed in the table working on the proposal, sharing the tasks presented in the scope of work, and preparing the final report. For most of the projects, the partners were the companies with problems being addressed in the study or the agencies/organizations that provided information, relevant data, or review comments.

Ten Center-conducted studies received financial support from federal and regional organizations in FY'94.

Several of the projects listed in Table 5-4 had technical assistance as a major component. The other projects collected information about existing pollution prevention activities and resources, as well as waste management problems and possible solutions, and prepared new materials on these subjects for distribution. Most of these studies have been mentioned in the discussions of the Center's technical assistance activities in Chapter 3 and in the interactions of Center staff with other agencies, organizations, businesses, and individuals described in Chapter 4. On the next few pages, results from three of the projects that ended in FY'94 and the objectives of one that began this year will be provided.

1. Pollution Prevention Information Resources

In an effort to determine the extent to which pollution prevention information is being provided in the Great Lakes region of the United States and Canada, Center staff sent a survey to 450 known or likely pollution prevention information providers in the region. The funding agency, The Great Lakes Protection Fund, required that the project convene an Advisory Committee of representatives from the Great Lakes states and provinces. This Committee assisted HWRIC's project team in developing the survey, identifying the survey recipients, and evaluating the survey results.

The project also analyzed the completeness of the information in filling the needs of the industry clients making information requests, then recommended strategies to better meet those needs, and identified resources necessary to implement those strategies.

The survey inquired about the nature of the pollution prevention information available, the methods used to deliver the information, and the survey participants' perceptions of the client's satisfaction with what was sent. A total of 122 or 27% of the surveys were returned completed.

TABLE 5-4: EXTERNALLY FUNDED PROJECTS

Project Title	Funding Agency	Participating Partner
Analysis of Cleaning Agents for Army Rotary-Wing Aircraft	Construction Engineering Research Laboratory	US Army Corps of Engineers
Class V Well Pollution Prevention Assistance in Peoria and Tazewell Counties, IL	US Environmental Protection Agency Region 5	Peoria and Tazewell County Municipalities, Illinois EPA
Development of an Industrial D Waste Database	US Environmental Protection Agency	Illinois EPA
Great Lakes Pollution Prevention Networking and Communications Strategy	US Environmental Protection Agency	Great Lakes Pollution Prevention Roundtable Members
Paint Waste Reduction and Disposal Education Program Development Year 2	Environmental Protection Trust Fund	Illinois Paint and Coating Industry
Pollution Prevention for the Greater Chicago Area	US Environmental Protection Agency	Metropolitan Water Reclamation District of Greater Chicago, City of Chicago-Department of Environment, Illinois EPA
Pollution Prevention of Industrial D Waste in Illinois	US Environmental Protection Agency	Illinois Foundries
Promotion of Pollution Prevention Opportunities through Evaluation and Implementation of Solvent and Technology Alternatives for Cleaning	US Environmental Protection Agency Region 5	Illinois Department of Commerce and Community Affairs, Illinois Industries
Regional Pollution Prevention Information Resources: A Planning Study	Great Lakes Protection Fund	US/ Canada Great Lakes Region Advisory Committee
Stable Isotope Evaluation of Soil Metal Speciation by Selective Extraction	Waterways Experiment Station	US Army Corps of Engineers

Surveys Sent and Returned Comparison by Organization Type

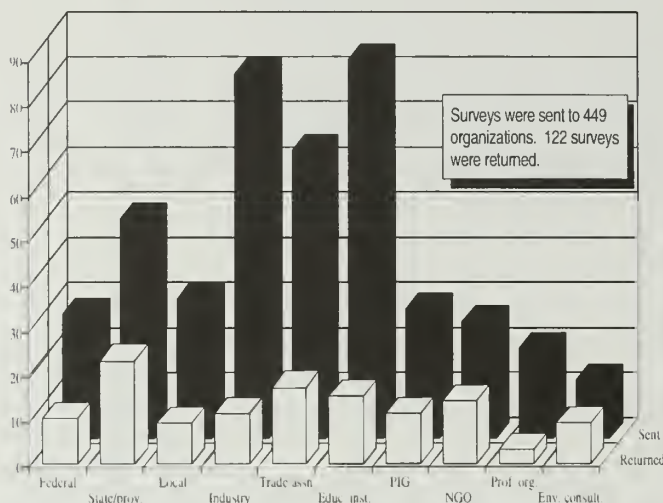


FIGURE 5-2: SURVEYS SENT AND RETURNED FOR GREAT LAKES P2 INFORMATION PROJECT

Figure 5-2 characterizes the responses by organizational type and compares the number of surveys sent to each group with the number returned.

The survey showed that there are many organizations, including environmental technical assistance agencies, university libraries, companies, and trade associations that have begun to provide pollution prevention information and the number is increasing annually. Without some system of networking, unnecessary duplication of effort will result from this proliferation of providers. The Advisory Committee, in conjunction with HWRIC's project team, recommended that a Great Lakes regional pollution prevention information network be established. Sharing of resources through this network would reduce duplication, save time and money, and allow staff to

focus more on dissemination and outreach rather than building redundant collections. The study suggested that information providers can serve their clients better by improving information sharing among their organizations, cooperatively developing key pollution prevention information materials, and working together to keep their information current.

Although this project is completed, Committee and project team members continue to work together and with other information providers to create and deliver value-added pollution prevention information to industries. Networking with providers from other regions through the efforts of the National Pollution Prevention Roundtable and of USEPA has been proposed. Center staff are now part of a team working on the next generation of information delivery systems to promote pollution prevention in industry.

The two reports prepared for this project, *Great Lakes Pollution Prevention Information Resources Catalog* (HWRIC TN 94-033), and *Great Lakes Pollution Prevention Information Resources: Current Status and Future Recommendations* (HWRIC TN 95-041) are available from HWRIC's Clearinghouse.

2. Industrial-D Waste Investigations

Subtitle D or nonhazardous industrial wastes are diverse and complex in nature and vary in risks posed to human health and the environment. The potential hazard of each waste is directly related to chemical composition and to how the waste is managed. During FY'94, Center staff completed two USEPA-funded projects that investigated the nature of these wastes and management and reduction opportunities.

The first project was to identify pollution prevention opportunities and techniques/technologies for industries that generate nonhazardous industrial wastes.

Four industries were initially targeted because of the large amount of Industrial-D wastes they generate. The industries are in the following Standard Industrial Classification (SIC) areas: chemicals (SIC 29), primary metals (SIC 33), pulp and paper (SIC 26), and petroleum refining (SIC 29). HWRIC worked with trade organizations to identify companies within these industry classifications that would be interested in participating in the study. With the assistance of the Illinois Cast Metal Association, a division of the American Foundrymen's Association, three foundries were located and agreed to participate in the project. On-site assessments were used to identify existing efforts to reduce waste, to assist the facilities in implementing additional waste reduction techniques/technologies, and to evaluate the success of all of the techniques/technologies being used.

With the assistance of the Illinois Cast Metal Association, three Central Illinois foundries participated in HWRIC's Industrial-D special wastes project.

Although the wastes produced by these foundries are nonhazardous, Illinois regulations classify them as special wastes which must be manifested. Foundries are required to obtain state and special waste generator identification numbers. The principal nonhazardous process waste for all of the foundries was waste sand used in molding operations. The cost for disposal of a 20 ton load of waste sand in 1992 was \$163, so efforts to reduce the amounts of sand disposed could be financially beneficial. Although representatives from all three participating foundries felt that they already recycled as much sand as possible, their facilities did often each still generate a 20 ton load of waste sand to dispose of each week.

Other waste reduction efforts in place at one or more of the three foundries included: metal recycling, cardboard and fiber drum reuse, other drum recycle or return, and chemical substitution to less toxic paints and binders. One foundry had even developed a formal pollution prevention plan, and staff were in the beginning stages of implementing the options proposed in the plan. HWRIC's project team had inadequate time to investigate and suggest other technologies, so efforts were concentrated on encouraging pollution prevention techniques to make them part of the routine operations of all three participating foundries.

Foundry personnel expressed some concern about new regulations which might mandate technology requirements. All three participants are small companies that lack the capital to make significant technology changes. All of the participants, however, agreed that waste reduction must be encouraged because it reduces expenses and can help them comply with existing and potential future regulations. The final report for this project is in review and should be available in Spring 1995.

The second Industrial-D waste project had as a goal characterizing and ranking the relative environmental risk of such wastes. The project used data from Illinois and Pennsylvania as representative of wastestreams generated in major industrialized states. The goal was to develop a conceptual waste tracking system for determining the potential hazards of these wastestreams and improving management of the wastestreams. Currently there is a great deal of variation between state programs that regulate these Subtitle D wastes. Many states are interested in regulating these wastes more closely and are in the process of developing more stringent regulations. Illinois' program is considered progressive since wastes managed off-site must be manifested, and on-site management techniques are permitted based on the waste processing source or specific characteristic of the waste.

Center staff worked most extensively with the Illinois data. The data were analyzed for internal inconsistencies, normalized, and statistically analyzed. An automated system was developed for assigning wastestreams into nine broad categories based on their chemical composition, their wastestream descriptors, and occasionally their SIC classifications. The waste categorization system that was developed easily groups wastestreams by chemical composition and uses the premise that the potential hazard posed by a wastestream is directly related to its chemical composition. Center staff also modified HWRIC's Degree-of-Hazard program to provide toxicity ratings for each wastestream. All of this information was used to develop a prototype database for Subtitle D waste that can be used on a personal computer.

The database provides a framework by which wastes can be easily described, then automatically assigned waste categories, risk factors, and management codes. The prototype system further allows waste generators and disposal facilities to electronically submit the required data to USEPA where staff could then use the database as a modeling and management tool. Staff at the generator and the disposal facilities could use the system to explore toxicity reduction alternatives and to do waste characterization analyses.

The project report provides a discussion of the regulations of these wastes in Illinois and Pennsylvania, characterizes the volume and toxicity of these wastestreams, presents a waste categorization system based on chemical composition, assesses the hazards of the waste based on toxicity, and presents a prototype for a national database. The report is in final review and will be available in Spring 1995.

3. Solvent and Technology Alternatives

Federal and state legislation enacted or amended during the 1990s sought to reduce risks to the environment and human health by severely restricting releases to the air, water, and land. Many of the chemicals restricted or phased-out by these regulations have historically been used in the metal fabrication and coating industries. In Illinois, these industries rank among the top five generators of the 17 chemicals targeted by USEPA for reduction under their 33/50 program. For metal fabricating and coating facilities, careful and thorough cleaning of parts prior to further treatment, such as coating or painting, is essential to achieving the quality, protection, and durability that is being sought by the treatment operation. Regulatory restrictions on cleaning compounds, which are most frequently chlorinated solvents, coupled with the push to protect the environment through incorporation of source reduction in all aspects of a company's operations, have encouraged many companies to look for alternatives to the compounds they currently use. The switch to less toxic products is just a first step in this pollution prevention effort, because these alternate cleaners also result in wastes that present potential hazards and must generally be treated before disposal.

For this project, HWRIC staff will examine in detail some of the available cleaning alternatives, and work with companies to implement use in their facilities. HWRIC staff will also explore the possibilities of adopting techniques and technologies to recycle/reuse the cleaning solutions, which could result in significant reductions in the amount of waste generated by a cleaning process.

Many of the chemicals restricted or phased out by the 1990 amendments to the Clean Air Act have historically been used in the metal fabrication and coating industries. Many such industries are located in Illinois.

Industry participants will be obtained through DCCA's and HWRIC's existing technical assistance programs and through other business assistance groups. Cooperation and interaction between HWRIC and DCCA have been ongoing and directed at providing the best possible assistance to those companies needing help. This project will expand those efforts by increasing the size and technical competence of each program's staff. It will also provide another opportunity for both HWRIC and DCCA to continue working with other state and federal agencies and industry groups to promote pollution prevention.

Besides testing cleaning alternatives for companies, HWRIC staff provide on-site assistance in making the change to the less toxic alternatives. The Toxics Release Inventory (TRI) will be used to identify specific facilities that have been successful in reducing their releases. These industries will be contacted and information on their source reduction activities obtained. The applicability of these techniques to other companies will be explored and factsheets of the successes will be prepared. Because the project runs for two years, there is an opportunity to examine reductions over several years, and TRI data can be analyzed back to 1988. TRI data will also be used to look for companies with high releases that might benefit from assistance by the project team. At the end of the project, the TRI data and the supplemental material obtained from successes in reducing TRI releases will be examined along with the actual measures of source reduction from the project case studies. Taken together, these should provide a reasonable estimate of the potential for waste reduction through adoption of the techniques and technologies examined in this project.

HWRIC staff provide on-site assistance to companies making the change from solvents to the less toxic alternatives.

4. Special Laboratory Projects

The Laboratory Services Program (LSP) was involved in several projects that went beyond simple analyses. In a project that had its roots three years ago in a research effort conducted by the UIUC Forestry Department, LSP staff assisted Argonne National Laboratory scientists in exploring new ways to delineate contaminated groundwaters. Rigorous methods were developed to prepare and analyze various tree and plant tissues for the presence of chlorinated hydrocarbons such as carbon tetrachloride. Once established, these methods were then applied to a variety of plant tissue samples collected by Argonne researchers over contaminated aquifers in Kansas and Nebraska. The research effort, which is ongoing, seeks to develop techniques by which tissue samples from trees growing over relatively shallow groundwater can be used to screen for contamination, thereby minimizing the need to drill expensive wells.

In another project, LSP staff worked closely with researchers from the U.S. Army Corps of Engineers Construction Engineering Research Laboratory (CERL) in Champaign to identify toxic components of wastestreams emanating from aircraft washing operations at several Midwestern bases. HWRIC lab staff applied their experience with high performance liquid chromatography (HPLC) analysis of surfactants to characterize the concentrations of contaminants in the wastestream. They also performed Microtox toxicity tests (see Figure 5-3) on the wastewater samples and correlated toxicity to surfactant concentrations.



FIGURE 5-3: HWRIC QA SPECIALIST CONDUCTING MICROTOX TESTING ON WASTEWATER SAMPLES

The studies suggested that components other than surfactants from the aircraft washing operations were involved in the toxicity effects observed at wastewater treatment plants at the bases where samples were collected.

A second study, with the U.S. Army's Corps Waterways Experiment Station (WES) in Vicksburg, Mississippi will continue to explore methods for metals speciation in soils. Metals can exist in soils in a number of different forms (species). The form in which the metal is found can influence the selection of an appropriate technology to remediate the soil. LSP staff have been working to prepare model soils, extract metals of interest, and analyze the extracts. The unique analytical capabilities of the Center's inductively coupled plasma/mass spectrometer (ICP/MS) have been applied to these analyses. Results of this effort should provide guidance to the Army in making remediation technology choices for metal-contaminated sites.

LSP staff continue to work closely with other Center staff on several projects that have required considerable methods development work. Staff continue to refine the surfactant/oil separation procedures that facilitate evaluation of the effectiveness of ultrafiltration in cleaning oily wastewaters for parts washing operations. This work is in part necessitated because of the large number of different surfactant formulations and oils used by the various firms who have sought HWRIC assistance. LSP staff have also worked with Center researchers to develop test procedures for measuring sorption of gasoline components to activated carbon from several suppliers and in developing analytical methods to measure water soluble organic components of cleaning solutions.

D. Research Plan for FY'95

In addition to the 15 projects that continue into FY'95 (Table 5-2), the Center was able to support six new projects. These include investigations of pollution prevention opportunities and technologies, improvements in and evaluations of bioremediation methods, and investigation of stabilization as a disposal option. The project titles and investigators for these new Center-funded efforts are listed in Table 5-5 on the following page.

Six of the Center-conducted projects listed in Table 5-4 will continue in FY'95. Technical assistance to achieve compliance and encourage pollution prevention will continue to be offered to companies with Class V injection wells in Peoria and Tazewell counties and to businesses served by the Metropolitan Water Reclamation District of Greater Chicago.

TABLE 5-5: NEW PROJECTS

Title	P.I./ Affiliation	Project Duration (Years)
Pollution Prevention Technologies/Techniques		
Total Cost Assessment: Catalyzing Corporate Commitment to Pollution Prevention in Illinois	White/ Tellus Institute	2
Synthetic Studies of a Water-Soluble and Recyclable Organotin Reagent	Gaston/ Southern Illinois University @ Carbondale	3
Physical and Chemical Characterization of the Dental Waste Water Stream	Caillas/ University of Illinois @ Chicago	2
Remediation Technologies		
High Rate Bio-Oxidation of Dichloromethane by Denitrifying Bacteria	Freedman/ University of Illinois @ Urbana-Champaign	2
Innovative Evaluation Methods for Bioremediation	Rittmann/ Northwestern University	2.25
Waste Management Options		
Accelerated Aging of Stabilized Hazardous Wastes	Taylor/ Bradley University	2

The testing of solvent alternatives is being requested more frequently and will undoubtedly continue to increase. A study to produce educational materials on paint waste reduction and disposal options will come to an end in FY'95. As a result of this study, several factsheets related to the application and removal of paint are being prepared for distribution by HWRIC's Clearinghouse. A final report for the paint project will contain an extensive bibliography on paint waste reduction options, and will be available in late 1994.

During FY'95, Research Program staff will work to publicize the results of both internally and externally funded research projects through presentations and publications. Three editions of the *LINK* newsletter will be published to document the pollution prevention activities of the Great Lakes Pollution Prevention Roundtable members. At least two editions of HWRIC's newsletter will be prepared.

Research staff will continue to keep current on the types of research being funded on both national and state levels. The Research Program interacts with staff from other state and federal agencies, industry, and other groups by providing information, evaluating projects and reviewing reports and proposals. We actively participate in technical organizations, and work with these groups to help their members find answers to their waste management problems. We continue to look for experts in all fields of hazardous waste management to continue to learn about the latest developments and to help up review and improve the quality of our research publications. This association with other hazardous waste researchers helps us determine research priorities, avoid redundancy, and better select new projects for funding.

Chapter VI: Internal Resources Development

A. Introduction

Over the years, HWRIC has developed a number of resources and capabilities to better serve the businesses and citizens of Illinois. Continual development of these resources is critical to the effective operation of a service organization like the Center if it is to meet the changing needs of the state. Internal resources are important factors in the quality and quantity of these services. During FY'94, areas of HWRIC internal resources development included staff training, new analytical instrumentation, expanding access to information resources, and expansion of computerized tools to make fiscal and information operations more efficient.

Internal resources are the foundation on which the quality and quantity of our outreach services to the businesses and citizens of Illinois are built.

B. Laboratory Capabilities Development

Capital improvements were made to several analytical instruments to assist HWRIC's chemists in addressing the samples presented to the lab. A flow injection system was purchased for the inductively coupled plasma/mass spectrometry (ICP/MS) system allowing improved control of internal standard addition and, hence, improved quality of the metals analysis performed on this instrument. A mercury amalgamation system was also added to this instrument. This system provides improved sensitivity for the analysis of this important environmental contaminant.

Software upgrades to two analytical systems were also made this fiscal year. The high performance liquid chromatography (HPLC) software was upgraded to the Millennium system, and a new 486 computer was added to the system to allow full use of the new software. The software and hardware upgrades provide for more efficient use of the instrument and its various detectors. The Varian Saturn gas chromatograph/mass spectrometer (GC/MS) systems also received upgrades of internal operating software that increase the performance of these instruments. The upgrades facilitated the no-cost acquisition from Varian of their experimental MS/MS board. Lab staff are currently exploring applications of this significant new capability and providing feedback to Varian.

Some electrical modifications to the building were made out of remaining Capital Development Board (CDB) funds. These modifications included a phase sensor switch that will sense loss of phase in the power coming to the building and immediately shut down all building power. This modification was proposed because of previous phase loss problems and because of the considerable damage such conditions could do to the Center's sophisticated computers and instrumentation. In addition, an uninterruptible power supply was put in line with the Fison's research mass spectrometer to protect this sensitive instrument.

The laboratory standardized to one spreadsheet software package, QuattroPro for Windows, to accommodate ease of transfer of data reports between various chemists. This package will allow different members of our analytical teams to electronically participate in the creation of data reports and minimize the need for hand entry of instrument data.

Staff development continued as an important focus for the laboratory. HWRIC again took advantage of a number of training seminars offered by vendors as a cost-effective method to provide exposure to instrument applications and operations especially to junior staff. Selected staff participated in no-cost seminars on sample preparation techniques including microwave digestion and solid phase extraction, on new developments in ICP instrumentation, and on the MS/MS capabilities of the Saturn system. Several staff were sent to more formal training on liquid chromatography, the new Millennium software, ICP/MS operation and maintenance, Varian Saturn operation, and the software system operating the Fison mass spectrometer.

In addition, travel funds were made available to several senior chemists to attend national seminars on HPLC and ICP/MS. Most staff chemists attended the Pittsburgh Conference and Exposition on Analytical Chemistry in Chicago for at least one day. They were exposed to an exposition of new developments in analytical instrumentation plus numerous seminars on the application of this instrumentation to analytical problems. Finally, one chemist was able to visit for several days in the laboratories of USEPA in Cincinnati to gain some experience working with HPLC/MS.

The LSP has built a response group to handle the increasing analytical demands of the Pollution Prevention (P2) staff as they expand their efforts to reach more industrial clients. A liaison to P2 was designated to provide an interface point to the lab and to offer technical advice on sample collection and handling to P2 personnel.

Lab staff are developing new laboratory techniques that will be useful as HWRIC continues its efforts to help industry find alternatives to costly and environmentally unacceptable solvent cleaning processes.

A new Quality Assurance Specialist was added to the staff to provide oversight over P2 and other samples analyzed in the lab, and to assist in the conduct of larger analytical support efforts. The laboratory also continues to employ hourly UIUC student help to assist with the sample load.

In evaluating the effectiveness of alternative solvent cleaning processes for the removal of oil and other contaminants from metal surfaces, it is essential to have quantitative tests by which cleanliness of parts can be compared and evaluated. Center laboratory staff are working with pollution prevention staff to develop the capabilities to perform such tests in our laboratories. They have reproduced a method performed by industry that measures residual organic carbon on metal surfaces by applying a combustion technique that converts the oil to CO₂, which can then be accurately measured. This technique has been applied to the evaluation of the cleanliness of metal parts from several pollution prevention outreach efforts. In addition, the laboratory staff have been working on a simple solvent extraction technique that will be applicable to odd-shaped parts and may provide a considerable time-savings over the combustion method. This technique, which appears to be accurate down to 25 micrograms of oil per part, uses solvent washing of the part followed by detection by infrared spectroscopy.

Both techniques will be useful as HWRIC continues its efforts to help industry find alternatives to costly and environmentally unacceptable solvent cleaning processes.

Information Services Program staff manage the Library and Clearinghouse and the online databases for both, produce factsheets and technical reports, organize workshops, and coordinate or participate in other Center outreach efforts.

C. Information Resources Development

1. Library and Clearinghouse Collection Development

Fulfilling HWRIC's legislative mandate to compile, analyze, and disseminate hazardous waste-related information is the principal responsibility of the Information Services Program (ISP). The program manages the Library and Clearinghouse and the online databases for both, produces factsheets and technical reports, organizes workshops, and coordinates or participates in other outreach efforts.

HWRIC's core information resources are contained in its Library and Clearinghouse. The HWRIC Library contains close to 8,000 items, including books, government reports, journals, maps, video and audio tapes, and articles. The Library collection does not circulate directly outside the Center, but interlibrary loan requests are honored.

The Clearinghouse includes two collections of information materials. The first is the collection of HWRIC-produced reports which has over 100 items. Most of these are final reports on research projects sponsored by the Center. Also included are pollution prevention factsheets as well as technical and administrative reports.

The second Clearinghouse collection has over 200 items, including brochures, pamphlets, and other brief publications produced by HWRIC, IEPA, USEPA, and other agencies, arranged in 23 topical areas. We have obtained distribution permission for all Clearinghouse items. Clearinghouse reports are available to any clients — businesses, citizens, schools, etc. — located in Illinois or elsewhere. HWRIC charges a nominal fee for reports to recover some reproduction costs.

In FY'94, the HWRIC Library and Clearinghouse collections grew substantially, as illustrated in Tables 6-1 and 6-2.

TABLE 6-1: LIBRARY COLLECTION DEVELOPMENT, FY'94

HWRIC Library Collection Development FY'94	
Books	Added: 663 (50 more than in FY'93) Discarded: 31
Periodicals	Added: 13 (5 less than in FY'93) Cancelled: 1
Audio/visual materials	Added: 22 Discarded: 3
Article citations	Added: 2,563

TABLE 6-2: CLEARINGHOUSE COLLECTION DEVELOPMENT, FY'94

HWRIC Clearinghouse Collection Development FY'94	
HWRIC Publications	Added: 21 Removed: 9 (still available from NTIS) (out of print)
Non-HWRIC Publications	Added: 42 Removed: 15 (out of print)

Some HWRIC publications, mainly research reports, were not reprinted this year, because we were no longer receiving requests for them. All of these items are still available at the National Technical Information Service (NTIS) clearinghouse for state and federal government publications.

A special effort was made to broaden the scope of the pollution prevention materials in the Clearinghouse collection this year. Several items were added to the household hazardous waste section geared toward homeowners and parents, including three public health brochures about removing lead and lead products from homes. About 40% (17 total) of the new additions this year were to the P2-specific section. Some of the items added include the USEPA's *Clean Air Act Amendments Guide for Small Businesses*, which has proved very useful to our industry clients, and some of the USEPA "Design for the Environment" factsheets geared to proactive pollution prevention in various industry sectors.

A special effort was made to broaden the scope of the pollution prevention-specific section of the Clearinghouse collection this year. About 40% (17 total) of the new additions this year were to the P2 section.

Also added to this section were some USEPA "Waste Wi\$e" brochures that provide businesses with tips on solid waste reduction. HWRIC met with USEPA Region V staff on the Waste Wi\$e program this past fiscal year, and agreed to provide information support for a Waste Wi\$e grant project the Illinois Recycling Association is undertaking.

2. Information Services to HWRIC Clientele and Others

Use of Clearinghouse information materials and related services increased this fiscal year, as discussed in Chapter 3 of this report. Clearinghouse report distribution statistics appear in Table 3-1 in Chapter 3, organized by client type. Library service statistics are summarized in Table 6-3 on the next page. About 60% of the online searches were performed on UIUC databases that are currently free of charge to us. The remaining searches involved long distance telephone charges and/or usage fees.

Information Services Program involvement in leading or supporting other Center outreach efforts, ranging from on site workshops to remote teleconferences to educational programs, are discussed in detail in chapter 3 of this report.

TABLE 6-3: LIBRARY SERVICES, FY'94

HWRIC Library Services FY'94	
Services to Outside Clients	Requests for information answered: 171 Books lent: 52
Services to HWRIC Clients	Books and videos circulated*: 434 Requests for information answered: 247 Online literature searches performed: 156 (-33 from FY'93) Internet information searches performed: 30 (+30 from FY'93) Article reprints obtained via interlibrary loan: 126 Article reprints obtained via campus photocopying: 590
* Since 10/93, when circulation automated	

D. Special Waste De-listing System Development

The Degree-of-Hazard System (DOH) is a PC-based computer program that analyzes the potential hazard of a wastestream. Based on data from applications for waste generator permits, the DOH assigns a quantitative "risk factor" according to the regulations adopted by the Illinois Pollution Control Board in 1990 (Section 808, Appendix B, *Illinois Administrative Code*).

The DOH was updated in FY'94 to include a larger number of substances and a longer list of synonyms. There are now 568 items cited in the DOH, 469 of which have toxicity or carcinogenic/mutagenic values. All of the EPA Section 313 chemicals are included. Forty-six of the 50 substances on the IEPA Special Waste Stream Permit Application are included. The list of synonyms has been expanded to include more of the common names and acronyms.

The Degree-of-Hazard System has proven a very effective resource tool for companies that are working to "de-list" their wastes, that is, prove that the wastes are of low enough risk to human health and the environment to be removed from the regulatory requirements for Illinois special wastes. Once "de-listed," wastes can be properly disposed of at a less costly waste disposal site.

There are now 568 items cited in the DOH, 469 of which have toxicity or carcinogenic/mutagenic values.

E. Additions to the Hazardous Waste Database System

During FY'94, additions to the Center's hazardous waste database system resulted in an expansion of the types of data and the timeliness of the information it could provide. Most notable this year was the addition of the Historical Hazards GIS database from the Illinois State Museum. This system is a geographically referenced data set based on the Sanborn Fire Insurance maps. Researchers at the State Museum used their

The Historical Hazards GIS database covers over 500 Illinois cities, with information dating from 1849 and up through 1950.

knowledge of historic industrial practices to identify, from the Sanborn Maps, locations of businesses likely to have used various hazardous chemicals. The database covers over 500 Illinois cities, with information dating from 1849 up through 1950. This system is used to prepare maps pinpointing the locations of potentially hazardous sites within a specified radius of a study location. The primary users of the system have been consultants conducting Phase I environmental assessments.

Updated wastestream permit, manifest and hazardous waste data were obtained from IEPA and added to HWRIC's system. These data were used in a project sponsored by USEPA to analyze the characteristics of Industrial-D wastes in Illinois as well as to develop a prototype database with potential uses nationwide.

Other data were added to the system for the purpose of identifying or targeting industries in need of technical assistance from HWRIC's pollution prevention staff. A complete list of the databases or types of data added to the system is as follows:

- Historical Hazards GIS Database
- Historical Hazardous Substances Database
- Toxic Release Inventory 1992 - Illinois
- Toxic Release Inventory 1991 - Illinois
- Updates of Waste Stream Permit Data
- Updates of Special Waste Manifest Data
- Updates of Hazardous Waste Annual Report
- Non-Hazardous Waste Annual Report
- Dun and Bradstreet Data for Selected Areas of State
- Illinois County Business Patterns Database

F. Automated Purchasing/Accounting Project

HWRIC Data Management staff, in conjunction with Administration staff, have developed an internal automated purchasing/obligation tracking system to run on the Center's Local Area Network (LAN). The system includes several components, the first of which is the Electronic Blue Sheet (EBS, named for the paper form) that allows staff members to enter order requests for products or services from their office computers. Requests are electronically forwarded to managers for approval, and then routed on to the Purchasing Agent and the Director. The main goals of the EBS are to increase fiscal staff's response rate to purchase requests and to provide a more accessible log of purchases.

The Purchasing Agent transmits EBSs into the Obligation Tracking System (OTS). The OTS allows the Business and Finance Manager to immediately charge an order, which allows for more up-to-date calculations of available funds in each of the Center's budget lines. The data are then downloaded into a program running under the Great Plains Accounting System, a network-based, multi-user account package that provides for detailed data manipulation as well as detailed tracking of orders.

The combined purchasing/accounting system will allow the Center to:

- Save money by more rapidly processing purchase orders
- Keep better track of supplies, so orders can be made before stock depletion and within a timeframe that allows for discount purchases
- Consolidate orders to maximize volume discounts and state contracts
- Pay vendors on a more timely basis and thus avoid interest penalties, and
- Provide timely and accurate fiscal reports to the Center Director and managers.

The various portions of the combined system were operational by the end of FY'94. The system is currently undergoing user testing. Modifications to increase usability and user facility will be undertaken in FY'95. In addition, the system will undergo upgrades to its Great Plains component to keep the software up-to-date.

G. Internal Support

1. Computer Users' Support

Data Management staff provide support for the Center's personnel computing needs. In FY'94, a number of new desktop PCs were purchased which offer greater computing power for those users doing desktop publishing, presentation graphics, accounting, and programming. One of the older PCs was placed in a common area with a communications modem attached for accessing online services and electronic bulletin board systems such as Access Illinois. Another was set up to monitor our ever-increasing network traffic.

HWRIC's PCs have been configured to take advantage of the Center's direct connection to the Internet. While Internet access has been used for electronic mail for many years, there is an increasing interest in accessing remote sites that maintain databases, discussion groups, and even multimedia presentations. Software such as Gopher, Mosaic, and NuPop has been installed on some machines to allow personnel to become familiar with a greater range of Internet capabilities.

New network printers installed in FY'94 provide better quality output and greater speed at a lower cost per page. One of them provides high quality color output for use with our GIS mapping software. These maps are then provided upon request to businesses and organizations throughout the state.

2. Consultants and Services Database (CSD)

Since its inception, HWRIC personnel have made referrals to other sources of help an important component of our overall assistance effort. For this reason, the CSD was established in 1986 as a repository of information on consultants, analytical laboratories, equipment vendors, and other service providers in environmental management in the Midwest. The CSD allows HWRIC personnel to assemble lists of companies specializing in various service areas so that clients can get the assistance they need to reduce wastes and comply with environmental laws.

Updates to the CSD included implementing changes in the software it uses to allow access via the LAN, and by updating and correcting the company records.

3. Program Advisory Panel

The Center's Program Advisory Panel (PAP) includes members from industry, community organizations, and other governmental agencies, and exists to provide technical input on the direction of the Center's programs.

The Center's Program Advisory Panel members would like to see even more regional efforts on the part of HWRIC, particularly in providing technical assistance in the Chicago and St. Louis metropolitan areas.

The focus of the December 1993 meeting was on ways to improve our services to Illinois industry and to obtain more support from industry. PAP members would like to see even more regional efforts on the part of HWRIC, particularly in providing technical assistance in the Chicago and St. Louis metropolitan areas. PAP members from trade associations indicated their willingness to disseminate information on HWRIC's services to their clientele, and encouraged more information dissemination from HWRIC, with particular emphasis on successful waste reduction case studies.

The PAP is interested in the Center's continued efforts toward creating an industrial affiliates program that would truly give participants some unique opportunities, particularly to use HWRIC laboratory capabilities and University of Illinois student interns. However, they recognize that industry is much less willing to invest in affiliates programs unless these programs can meet very specific industry needs.

Chapter VII: Sustainable Illinois

A. Vision for the Future

The Center's Sustainable Illinois Initiative recognizes that environmental protection and enhancement, so important for our human well being, need to be balanced with our state's needs for jobs, a strong economy, and productive industry. Below we elaborate some of the background on sustainability and some of our specific program activities toward the goal of a Sustainable Illinois.

Keoleian and Menerey state in their review paper on sustainable development by design, "Substantial evidence suggests that current patterns of human activity on a global scale are not following a sustainable path." (1) They argue that the product life cycle analysis is a useful design framework for understanding the links between societal needs, economic systems, and their environmental consequences.

Sustainable development is defined as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." For wealthy nations, sustainable development involves "maintaining economic growth while producing the absolute minimum of new pollution, repairing the environmental damages of the past, using far fewer nonrenewable resources, producing much less waste, and extending the opportunity to live in a pleasant and healthy environment to the whole population." (2) It is seen by Keoleian and Menerey as a dynamic state that harmonizes economic activities with ecological processes.

In a recent Associated Press newspaper article, Ismail Serageldin, World Bank vice president for economically sustainable development, was quoted as saying that if current trends continue, more than half the world's population will live in big cities by the year 2020, endangering natural resources, economic development and the environment. (3) Big cities are growing at an estimated rate of a million people a week, and according to Mr. Serageldin, natural resources are deteriorating on an unprecedented scale as cities scrounge for water and land.

The same article notes that Henry Cisneros, U.S. Secretary of Housing and Urban Development, said that American cities are already suffering from uncontrolled growth: whole communities are bereft of jobs, packed with poor people and generally unhealthy due to waste left behind by industry.

Porter and Islam discuss an agenda for the United States as a follow-up to the Earth Summit in Rio. (4) One aspect of the Rio Agreements is Agenda 21, which is intended to be a comprehensive workplan for national actions and international cooperation for sustainable development now and into the 21st century. One constructive provision of Agenda 21 calls on governments to develop, with broad-based participation, their own national strategies for sustainable development.

The Center's Sustainable Illinois Initiative recognizes that environmental protection and enhancement, so important for our human well being, needs to be balanced with our state's needs for jobs, a strong economy, and productive industry.

In discussing the need to begin a research program on sustainable consumption and production patterns in the United States, the authors state that for the U.S. to make progress toward becoming a sustainable society in the coming decades, it must have a vision of what that society will look like. We must also know what patterns of natural resource use will be sustainable into the next century.

HWRIC's goals have been to address the state's present (and future) waste management problems and to find both short and long term solutions to these problems. We have focused on pollution prevention, in the broadest sense, to provide a basis for a long term solution. We must collectively direct our energies into a larger effort to ensure that the state's industrial base and environmental resources will be sustained into the future.

HWRIC's goals have been to address the state's present (and future) waste management problems and to find both short and long term solutions to these problems. We have focused on pollution prevention, in the broadest sense, to provide a basis for a long term solution. We must collectively direct our efforts, including education, remediation of contaminated sites, improved treatment and resource recovery systems, and pollution prevention, into a larger effort to ensure that Illinois' industrial base and environmental resources will be sustained into the future. To support that effort, HWRIC will continue to encourage the effective use of raw materials, and will seek to further protect and enhance our natural resources through improved treatment and disposal technologies, and remediation of existing contaminated sites.

Providing for a sustainable Illinois means that we carefully evaluate the environmental and human health risks of our activities, and commit our limited resources to those problems that will have the greatest impact on our future. A major step in this process was completed with the preparation of the Critical Trends Assessment Project (CTAP) report. (5) An overview of these trends can be found in the summary report. HWRIC's section of the CTAP technical reports, Volume 5, deals with *Waste Generation and Management*. HWRIC focused its activities on the industrial sector because that is within our mandate and because we believe that industrial productivity and competitiveness must be encouraged and environmental protection must be enhanced.

This chapter of our annual report discusses the concept of a sustainable Illinois and HWRIC's future activities and priorities that will move us, as a state, closer to the goal of a sustainable future. Environmental protection and enhancement, so important for both our physical and spiritual well being, need to be balanced with our state's need for jobs, a strong economy and productive industry.

B. Overview of HWRIC's Role in Sustainable Development

A number of HWRIC's activities are designed to bring us closer to a Sustainable Illinois. These are discussed briefly below, with a view toward where future efforts might further progress toward that goal.

- *Remediation of Contaminated Sites* — Illinois, like most other states, has numerous sites contaminated by past industrial or disposal activities. Siting of new industries tends to be on new or clean sites ("green site development"). This process removes more land from agricultural production, and leaves abandoned industrial sites ("brown sites") in our cities where the jobs associated with the new industry are most needed, and where the infrastructure is already in place to support development.

HWRIC has sponsored research on the nature and extent of contamination in two major areas of Illinois: the Calumet area of Southeast Chicago and the American Bottomlands near East St. Louis. We will continue to work with policy makers and city officials to examine ways to restore these sites to a level acceptable for new industrial development, to use our data resources on contaminated sites for land-use planning, and to assist in the redevelopment of these areas.

- **Pollution Prevention** — HWRIC’s Pollution Prevention (P2) Program is designed to help industry reach compliance with state and federal regulations, provide long term protection of workers and the environment, and operate in a more efficient and competitive manner. Specific activities to promote the pollution prevention ethic, and to help industry adopt specific P2 techniques and technologies, are discussed in this report.

The opening of HWRIC’s Chicago Office will help us reach a much larger number of industries by adding technical assistance staff located in proximity to over 60% of Illinois’ industries. By co-locating this office with the Chicago Manufacturing Center (CMC), we will be able to expand our P2 efforts by providing our services to companies which are working with CMC to modernize, improve competitiveness and upgrade technologies.

We are also expanding our research and demonstration project capability to evaluate the effectiveness of new technologies and techniques for reducing waste. We will also continue to help Illinois companies incorporate environmental concerns and considerations into all aspects of business development as an essential component of progress toward a sustainable future.

Pollution prevention has been defined by Congress and by USEPA as primarily source reduction. Industry has looked at P2 more in terms of release reduction, that is, preventing pollutants from leaving the plant site and getting into the environment. HWRIC is looking at P2 in the broadest sense, as including any activity that will lead to a reduction in waste before it is ever generated. This includes source reduction of all waste, including water and energy usage, and the elimination or reduction of waste through improved process and product design, total quality management practices, preventive maintenance, etc. Our ultimate goal is to make pollution prevention a routine business practice that incorporates environmental considerations into everyday decision-making.

- **Education** — Each citizen has a significant role to play if Illinois is to achieve a sustainable future. Whether we are buying “cleaner” products and less packaging, or participating in a recycling program, there are a number of things that each of us can do at work or home to reduce waste and to make better use of our natural resources. This level of environmental awareness and appreciation has to start in the schools.

Although many of our efforts to date have been with institutions of higher learning, we recognize that much needs to be done in grades K-12. HWRIC has helped institutions of higher learning identify their waste management problems and better manage their waste. We have worked to support the development of curricula on pollution prevention, not only in engineering schools, but also in business schools.

The opening of HWRIC’s Chicago Office will help us reach a much larger number of industries by adding technical assistance staff located in proximity to over 60% of Illinois’ industries.

The message at its basic level is simple: environmental protection has to be a part of everyone's job and of concern to everyone, no matter what their job description.

- *Treatability Studies* — Wastes will continue to be generated by industry, so it is important that these wastes are treated to minimize potential environmental impacts, and to recover raw materials wherever possible. HWRIC will continue to expand the use of its laboratories and instrumentation to characterize wastestreams and residuals of treatment, and to analytically support source reduction activities. In some cases, a waste from one process can be treated to make it an acceptable raw material for another process. We will also continue to define barriers to reuse and to develop the markets and means to make such reuse accessible.
- *Information* — As a government agency, the Center will always play an active role in the collection, analysis and dissemination of information. Whether it is consumer-oriented for the homeowner, policy-related for government officials, or technically oriented for industry or other researchers, information will be key to our efforts to further the collective knowledge of waste management, pollution prevention, and environmental issues.

HWRIC has maintained a lead role in the information revolution, and has furthered the exchange of information both regionally and nationally through contracts with the Great Lakes Protection Fund and with USEPA. The advantage to Illinois of this leadership role is that we can provide citizens and businesses with the most up-to-date information available. A sustainable future will require that we understand the nature and extent of our environmental, economic and development problems, and the potential solutions. To effectively use our limited time and resources we must learn from and build upon the experiences of others.

HWRIC is in a good position to help define the road to a sustainable Illinois and to assess progress along it.

- *Training* — Although this activity is related to both education and information efforts of the Center, it remains distinct as a way of collecting and presenting specific information. The Center has been involved in a number of different pollution prevention training activities, from down-linking teleconferences on strategies for industries, to providing general workshops on techniques and technologies and more focused sessions for specific industrial facilities. We have also provided training sessions to IEPA industry interns, and agency staffs from USEPA and the Metropolitan Water Reclamation District of Greater Chicago. The training of staff from government agencies and industry will increase in importance as a tool to help ensure a more sustainable future.

These activities have placed HWRIC in a position to help define the road to a sustainable Illinois and to assess progress along it. Some of the program enhancements that we envision to improve the Center's ability to address sustainability are discussed in the remainder of this chapter.

C. Building Foundations

HWRIC is currently organized to respond to a variety of P2 and hazardous waste issues from Illinois industry and citizens. We need to build on our current infrastructure to meet the increasing demands that our commitment to building a sustainable Illinois will bring.

1. The Education Component

Educational outreach efforts at HWRIC span a broad range of constituencies. Currently the more traditional K-12 groups receive only cursory attention as allowed by staff time constraints. The Laboratory Services Program provides tours of the laboratory to groups requesting this service and also participates in the American Chemical Society's National Chemistry Day by opening the laboratories for instructional tours for high school and community college students. However, relatively few proactive measures are taken to develop more outreach activities for this constituency. Higher education receives more attention partially due to the more technical, scientific nature of the work in which the Center is involved. Through two research projects completed this year, the Center can now offer P2 curriculum packages for both engineering schools and schools of business and management.

For the concept of sustainability to be accepted and implemented, it must be supported at the grass roots level. Providing adequate educational outreach efforts is consequently a vital component to addressing this goal. To be effective in this area, HWRIC needs to hire a full-time Educational Materials Development Specialist and develop a comprehensive program. Filling this position will be a priority over the next few years.

Some of the specific activities that could be undertaken at the K-12 level include:

- Developing P2 materials that are useful to classroom teachers in meeting their state-mandated obligations
- Submitting proposals for upcoming science literacy grant programs for high school students
- Developing program materials for schools with Career Day activities, and
- Developing a "visiting scholars" program where high school students can visit HWRIC for a week during the summer (expenses paid) to work in the laboratory or participate in site visits with technical assistance staff.

Specific activities that the Center will pursue for institutions of higher learning include distributing HWRIC's two P2 curriculum packages, holding specific topical workshops for university instructors and their classes, and continuing development of contacts with various University of Illinois units such as Illinois Satellite Network, Manufacturing Research Center, and Continuing Engineering Education. Other activities include developing curricula for accounting and law programs and promoting an intern program placing students into industries interested in developing their pollution prevention programs.

Through two research projects completed this year, the Center can now offer P2 curriculum packages for both engineering schools and schools of business and management.

For nongovernmental organizations (NGOs), we will explore developing a speakers bureau at the Center so community and other organizations can request presentations on a wide range of topics. We will also investigate producing a scripted slide show or short videotape of HWRIC activities and programs that can be used as an outreach tool on HWRIC's resources.

2. The Information Component

A sustainable future will require that we understand the nature and extent of our environmental and economic development problems, and the potential solutions to these problems. Information will be key to this effort.

A sustainable future will require that we understand the nature and extent of our environmental and economic development problems, and the potential solutions to these problems. Information will be key to this effort. As Jonathan Cannon, USEPA Assistant Administrator for Administration and Resources Management, said, "Information is critical to ecosystem management. Without information, we cannot manage personal, 'backyard', local or regional ecosystems." (6)

The Center has two information goals to aid our progress toward a sustainable Illinois:

- Be a part of a national decentralized clearinghouse for pollution prevention information and case studies to better enable us to assist industries and other clients, and
- Integrate both resource and pollutant data from all media (air, water and land) into one database system to better understand current conditions and recommend solutions.

Inherent in both goals is the concept of using technology for information creation, organization and dissemination in order to reach clients at all ability levels.

Since at least the early 1980s, environmental organizations in the United States have been utilizing information clearinghouses as mechanisms for distributing factsheets, guides and other materials to their clients, particularly industry. Since 1988, USEPA and many state environmental agencies have been working towards establishing a decentralized clearinghouse, or system of clearinghouses. (7) The clearinghouse concept could make P2 information more readily available on a regional basis while reducing duplication of effort by information providers. HWRIC has played a role in these efforts since our inception, by actively participating in workshops, the National Pollution Prevention Roundtable, the Great Lakes Regional Pollution Prevention Roundtable, and similar functions and organizations.

Budget and staff cuts for many government programs in the 1990s have made it even more imperative that organizations cooperate in providing information. Increasingly, the Center must look to others for resources we formerly purchased and maintained ourselves. Sustainable information resources will be those resources built upon a network of cooperation.

A decentralized national P2 information clearinghouse network is more attainable now than ever before because of the flourishing of information resources available on the Internet, the huge expansion of the networks that comprise the Internet, and increased numbers of computers on those networks.

We have already begun to make better use of the Internet both to more effectively access information materials and to share these resources with others. Electronic dissemination of information is an efficient means for transmitting the same message to a variety of clients. Electronically transmitting information also reduces the solid waste problem associated with printed materials.

Currently many of our clients do not have access to electronic information, but this is changing. Eventually we will be able to use the Internet to distribute information to our primary clientele, the businesses, citizens and educational institutions of Illinois. Cannon aptly states a long term goal that HWRIC shares: "In the long run, nothing can be more profitable than a National Information Infrastructure that empowers us to hand over a better environment and a sustainable, healthy economy to our children." (6)

Improving access to hazardous waste and pollution prevention data, and expanding the type of data gathered and maintained by HWRIC, will allow us to effectively support the long-term goals of the Center. Vast amounts of information are collected by local, state, and federal government agencies for a variety of purposes. Governments at all levels have begun to recognize the importance of data sharing and data standards which can help make information collected for one purpose usable for others.

A current use of our database is to target efforts in P2 technical assistance. Data are also requested by users outside the Center to address a range of environmental issues. By continuing to improve the accessibility and quality of our data, HWRIC will get more pertinent information to its data users to help them address areas of concern.

The Center will continue efforts to update our current database to have available the most current information. We will continue our dialogues with government agencies responsible for collecting environmental data, and will pursue additional electronic sources of such information. Data systems such as the Toxic Release Inventory have provided us insight into multimedia pollution issues. The growth of our database of contaminants being released to all media will allow us to better predict long-range environmental effects.

Our two goals of becoming part of a decentralized information clearinghouse network and expanding and integrating waste data will allow us to provide more timely information and easier access for our internal and external customers. We will be better able to customize our information products and database reports. Easier access to information through automated systems will enable the Center to deliver materials directly and quickly to clients.

Improving access to hazardous waste and pollution prevention data, and expanding the type of data we gather and maintain, will allow us to effectively support the long term goals of the Center.

3. The Analytical Laboratory Component

One formidable impediment to industry's adoption of pollution prevention practices in all phases of operations is a lack of understanding of the sources and components of the wastes produced. Factory waste audits and similar accounting practices can begin to address the source issues, but process and waste stream characterization will be required before a complete understanding is achieved.

One formidable impediment to industry adoption of pollution prevention practices in all phases of operations is a lack of understanding of the sources and components of the wastes produced. Process and waste stream characterization is required for a complete understanding to be achieved.

HWRIC provides analytical support as a component of its industrial assistance efforts. Laboratory staff provide chemical composition information on process and waste streams, often as part of evaluations of new technologies to reduce waste generation. Such services will continue to grow in importance as HWRIC expands its efforts to reach more industries.

HWRIC remains committed to providing high quality analytical assistance to both our research and industrial technical support efforts. We will continue to provide formal continuing education opportunities to our analytical staff to supplement on-the-job experience with industrial, agricultural and environmental samples. We will also continue to upgrade our equipment and to acquire new technologies to attempt to maintain the Hazardous Materials Laboratory as a state-of-the-art analytical facility. And we will identify and pursue the staffing needed to address new analytical challenges as they arise. Our laboratory resources will play a critical role as the Center, and society in general, strive to better understand the fate and effects of contaminants in our environment and to identify the routes by which pollutants reach our environment.

4. Building Partnerships

To carve out a path toward a sustainable environment and economy in Illinois, public and private sector organizations must work together. The full range of economic activities from farming, mining and other resource extraction efforts, to manufacturing, power generation, transportation, consumerism and waste disposal, impact the quality of our environment. A sustainable economy in Illinois requires an increased use of renewable resources in all these economic activities. But the environmental and economic consequences of using renewable raw materials must be carefully evaluated in each case. HWRIC can play a role here by providing pertinent information and supporting research and education.

As described in Chapter 4 of this annual report, HWRIC currently collaborates with other government agencies, researchers and business associations. These collaborations enable the Center to reach more businesses with P2 and waste management assistance and to extend our limited resources. Key partnerships with Illinois government agencies include cooperation with the Chicago Manufacturing Center, the Department of Commerce and Community Affairs, and the Cooperative Extension Service. Each of these partnerships is aimed at helping companies comply with environmental regulations through the use of P2 techniques and helping them become more competitive by modernizing their business practices.

We are also an active participant in the Governor's Science Advisory Committee which is leading the state's efforts to develop improved manufacturing technologies. In addition, HWRIC's Director is participating on the state's Technology and Jobs panel. HWRIC's primary role is to ensure that the environmental concerns of technology and the constraints of environmental regulations on competitiveness are considered.

To help achieve a Sustainable Illinois, state government must pursue opportunities to form partnerships with teaching and research institutions, business organizations, manufacturers, consumers, NGOs, and the federal government. Each of these sectors of the economy has an important role to fill. Some of the key roles are listed in Table 7-1 on the following page. Some of these roles, and the need for collaboration to achieve progress toward sustainable development in Illinois, are discussed below.

The extraction and use of natural resources is an example of the need for various sectors to collaborate. Illinois is blessed with many natural resources including fertile soil, and abundant water and coal, as well as more limited supplies of crude oil and various minerals. The geological resources are not renewable, and their extraction impacts the environment and requires land reclamation or other remediation efforts. New technologies and techniques for extraction of these resources and for restoration of the mined land need to be continually explored. Finding new uses for our coal and oil resources may increase their value to society. The combined talents and efforts of agribusinesses, researchers, conservationists, power generators and manufacturers are needed for this to be accomplished.

The key responsibilities of manufacturers and other businesses is to consider sustainability factors in designing products, selecting raw materials, designing and operating manufacturing processes that minimize impacts on the environment, and marketing those products. Manufacturers are increasingly being required to take responsibility for their products including the products' ultimate fate. As a result, many companies, including automobile manufacturers and computer chip makers, are designing their products for ease of disassembly and reuse. This use of products or components of products as raw materials in the next generation of production is known as "design-for-the-environment" and is an extension of pollution prevention concepts.

New production processes are usually developed by researchers in industry, government agencies, and universities. Several major research universities, industrial research organizations, and Argonne National Laboratory are located in Illinois and can play a role in developing sustainable businesses by focusing their research efforts on developing environmentally friendlier manufacturing processes. Public and private research institutions can undertake research on manufacturing processes and study their impacts on the environment and workers. HWRIC's Research Program can provide incentives for researchers to consider the environmental consequences of various technology alternatives and to look for cleaner production processes. HWRIC will continue to build on recent successes in technology research that are helping Illinois businesses prepare for a more competitive, environmentally friendly future.

To help achieve a Sustainable Illinois, state government must pursue opportunities to form partnerships with all types of agencies and organizations.

TABLE 7-1: ECONOMIC SECTORS AND A SUSTAINABLE ILLINOIS

KEY ROLES OF ECONOMIC SECTORS IN DEVELOPING A SUSTAINABLE ECONOMY IN ILLINOIS	
Sector	Key Roles and Responsibilities
Businesses (including manufacturers)	Product design Raw material selection Process design and operation Marketing Recycling, treatment and disposal options
Researchers (including universities)	Analyze impacts of government policies on businesses and on consumer behavior Develop efficient, clean manufacturing processes and products (Life Cycle Analysis)
Teaching Institutions	Educate students about sustainable development issues Provide outreach to industry
Government Agencies	Adopt and implement policies that encourage sustainable development: regulations, taxes, practices Provide information Foster technology transfer Identify and support pertinent research Develop sustainable transportation systems
Nongovernmental Agencies (NGOs; interest groups)	Advocate sustainable policies and practices Educate the public and others about sustainable development issues
Consumers	Become informed Choose or demand "clean" products: those that are produced with little waste generation, manufactured with renewable resources, or that are recyclable Reduce energy use Recycle materials

Teaching institutions, including secondary schools, need to develop curricula and research programs that address sustainability issues. Public interest groups and other NGOs influence government policies, consumer behavior and business practices. These organizations need to have access to public forums and resources. Consumers can play a significant role in sustainable development by becoming better informed regarding the impacts of their purchasing decisions. HWRIC can help each of these groups by providing synthesized and clearly presented information, and by sponsoring pertinent research projects.

Consumers can play a significant role in sustainable development by becoming better informed regarding the impacts of their purchasing decisions.

D. HWRIC and Illinois Business

HWRIC works with the state's businesses (primarily manufacturers and, to a lesser extent, agricultural groups) to help them improve their waste management practices, reduce waste and increase efficiency of operation. Energy usage and life-cycle considerations related to products and processes are a part of this evaluation. More specifics related to these issues, and their tie to sustainability, are described below. An important role for the Center is the testing, evaluation and promotion of clean technologies. Some of our work in this area is described in detail in Chapter 3.

1. Pollution Prevention and Competitiveness

Environmental pollution frequently results from a loss of raw materials associated with industrial or agricultural processes. These chemicals may ultimately end up in air, water and soil resources and cause harm to living systems. Lost raw materials represent inefficiencies within the processes that use them. American business is continually looking for opportunities to improve competitiveness through development of more efficient processes. P2 techniques provide an ideal framework to assist industry in these efforts while maintaining or advancing environmental protection.

Historically, companies have attempted to control emissions through end-of-pipe treatment alternatives, primarily in response to government regulations. Most environmental regulations have targeted specific pollutants or wastestreams while ignoring the root causes of the pollution problem, the processes from which the pollutants originate. Companies that comply with government regulations strictly through end-of-pipe solutions may miss out on opportunities to improve process efficiency.

Adoption of P2 techniques can help companies deal with their potential wastes in a proactive manner by addressing the source and cause of waste generation and ensuring that raw materials are used for their intended purpose rather than being released into the environment. Not only do companies that apply these practices benefit from improved regulatory performance, they often experience cost benefits associated with raw material conservation and improved worker safety. The state benefits through maintenance of a healthier environment, conservation of valuable raw materials, and an improved economy.

HWRIC has found that companies that have adopted pollution prevention and total quality management programs are often the ones that are growing and adding jobs. This is because both of these programs involve increasing the efficiency of operations and personnel at a facility. A sustainable future for Illinois companies will involve more and more of them adopting these strategies. HWRIC will play a strong role in facilitating the adoption of these programs.

2. Environmental Technologies

HWRIC has found that companies that have adopted pollution prevention and total quality management programs are often the ones that are growing and adding jobs. This is because both of these programs involve increasing the efficiency of operations and personnel at a facility.

Technology demonstration and development are important components of HWRIC's program to help Illinois businesses. HWRIC sponsors and conducts research on remediation, treatment and clean manufacturing technologies. Our work may involve improving an existing technology, developing or exploring new industrial applications for current or proven technologies, and/or demonstrating the effectiveness of new technologies. An important aspect of this research is to evaluate and compare the life cycle costs of existing and new technologies.

As mentioned in Chapters 2 and 3 of this annual report, HWRIC has the staff and facilities necessary to test different technologies and new products, such as aqueous-based cleaners. Many of the demonstration projects conducted by our staff (often in the Center's laboratories) have focused on liquid process streams and wastes resulting from metal cleaning and electroplating processes. Most of our treatment and remediation projects are conducted by outside researchers with funding and oversight supplied by our Research Program, although some projects also involve our staff and facilities. In some cases, we have helped researchers find sites to conduct their evaluations, and have provided analytical verification of the effectiveness of various treatment options.

We not only evaluate the effectiveness of improved or new pollution prevention or clean technologies to reduce waste, but also work with companies to help them implement the technologies. In many cases, multiple visits have been made to a company to troubleshoot problems and to ensure that implementation of a promising technology increases operational efficiency and reduces waste production.

For the future, we are working to build stronger partnerships with technology centers such as the Chicago Manufacturing Center, and with community colleges and universities that have established technology development and research programs. The Center's focus on helping small and mid-sized companies with practical, applied environmental technology evaluation problems is a service that nicely supplements and complements other technology development efforts ongoing in Illinois.

Developing technologies and creating jobs in an environmentally friendly fashion are important components for a sustainable future. Governor Jim Edgar, in a recent letter to Mr. Larry D. Haab, Chairman of the Illinois Coalition, called on the Coalition to spearhead an important new initiative to help set strategic directions for job growth and technology for the years ahead. Specifically, the Governor asked the Coalition to provide him a Technology and Jobs Agenda for Illinois that will lay out a strategic plan of action for the years 1995 to 2000.

This agenda will lay a framework for how the state can help industries and businesses in Illinois work toward sustainability into the coming century. HWRIC has an important role to play in this initiative with its Director serving as an active participant on the panel recommending the state's plan of action.

3. Life Cycle Assessment

It has become clear that we must begin to look more comprehensively at alternative chemicals, processes and products to ensure that we are indeed moving to more environmentally benign systems. Environmental "solutions" in the past, such as using polychlorinated biphenyls (PCBs) in transformers or chlorinated fluorocarbons (CFCs) as coolants/lubricants, solved some immediate environmental and human health problems but ended up creating longer term and more far reaching environmental problems. Life cycle analyses may enable our society to anticipate and hopefully avoid some similar problems in the future.

According to a recent report by Fava, et al. from the Society of Environmental Toxicology and Chemistry (SETAC):

"The life-cycle assessment is an objective process to evaluate the environmental burdens associated with a product, process, or activity by identifying and quantifying energy and materials used and wastes released to the environment, to assess the impact of those energy and materials uses and releases on the environment, and to evaluate and implement opportunities to affect environmental improvements. The assessment includes the entire life cycle of the product, process, or activity, encompassing extraction and processing of raw materials, manufacturing, transportation and distribution, use/re-use/maintenance, recycling, and final disposal." (8)

HWRIC will be addressing some of these life cycle issues in a number of the projects that it is undertaking and in some of the research projects that it funds. In our laboratory work on alternative solvents, we will be addressing the toxicology of some of the new solvents and their ultimate fate once they are disposed. In this case, many are aqueous-based solvents that will eventually be discharged to local sanitary districts. In a new research project being undertaken by professors in the Civil Engineering Department at the University of Illinois, Urbana-Champaign, the researchers will examine life cycle design considerations for a floor tile manufacturer. The end product of this research will be a formal methodology for integrating multiple impacts, which were previously outside the designers' domain, directly into the product engineering design process.

A move toward sustainability will require that the Center take into consideration life cycle implications in much that we do or that we recommend for industry. Research in this area can further our knowledge of the trade-offs that occur with various alternatives (products and/or processes) and allow us to make better recommendations to policy makers.

A move toward sustainability will require that the Center take into consideration life cycle implications in much that we do or that we recommend that industry do.

4. Agriculture

Agriculture, like most production sectors, has undergone numerous changes over the past century which have resulted in dramatic increases in productivity. The use of larger machinery, increased application of fertilizers and pesticides, and the planting of fewer varieties of crops in larger fields have generated numerous questions about the sustainability of modern agriculture. Discussion generally focuses on soil erosion, chemical contamination and long-term impacts on the land ecosystem. Additionally, agricultural economists are looking at the costs and benefits of optimum versus maximum production levels.

HWRIC will be expanding efforts in sponsoring research projects and gathering information on the optimum use of agricultural chemicals, movement and degradation of chemicals in the environment, cleanup of contaminated sites, and safe distribution and storage sites.

Like other industries, agriculture has taken both voluntary and mandated steps to address these concerns. Major changes in tilling practices are reducing erosion. Numerous persistent pesticides are no longer used. Several major farm suppliers are using computers and satellites in combination with soil testing to implement precision farming. This latter technique uses modern technology to apply optimum amounts of chemicals to each acre. By varying the rate of application, the farmer is able to save money by neither over- or under-fertilizing portions of fields.

Soil eroded from the land is commonly acknowledged as the greatest contaminant of the nation's rivers. Recent studies by the U.S. Geological Survey provide insight into the amount of agricultural chemicals that currently run off the land with the eroded soil. (9) Using river water samples, USGS estimated that 539,000 kilograms of atrazine and 827,000 metric tons of nitrate-nitrogen were carried to the Gulf of Mexico by the Mississippi River between April and August in 1993 (the year of the Great Flood). The atrazine load was 235% higher and the nitrate-nitrogen load was 112% higher than for the same period in 1992. In economic terms, farmers spent well over \$250 million to apply the chemicals that washed away in 1993. There is no question that both the environment and the farm economy will benefit from efforts to successfully find ways to reduce this waste.

There is currently great interest in reducing agricultural waste and improving the sustainability of agriculture. Public attention is focused on many related issues, including ground and surface water quality, erosion control, siting of industrial facilities on contaminated "brown sites" rather than farmland, chemical residues in foodstuffs, the long-term productivity of the land, and environmental justice (ensuring that pollutants do not overwhelmingly effect some population sectors, e.g. lower economic classes or people of color, more than others).

HWRIC has sponsored research on the air deposition of agricultural chemicals and cleanup of pesticide contaminated soil. With our diverse staff, research and analytical labs, and information resources HWRIC is well-situated to cooperate with other governmental, agricultural and private entities in future efforts to address agricultural sustainability issues.

HWRIC envisions expanding its involvement in this area by sponsoring research and gathering information on the optimum use of agricultural chemicals, movement and degradation of chemicals in the environment, cleanup of contaminated sites, and safe distribution and storage sites.

The basic P2 concepts that are helping manufacturers reduce waste and improve efficiency are equally applicable to agriculture. HWRIC can collect and disseminate information on this topic. Additionally, we have the capability to store and analyze data that will help evaluate trends in agricultural practices and impacts of innovative techniques.

The long-term future of Illinois largely depends on maintaining the quality and usefulness of its soil and water. HWRIC will help the state realize this future by assisting in finding ways to: remediate existing contamination; prevent additional sites from becoming contaminated; and, improve the practices employed by modern agriculture.

5. Energy Use

Although HWRIC's mandate is to deal with various waste issues (chemicals and materials), it is increasingly clear that energy usage is also an important consideration for our program. Both waste production and energy use must be considered when helping an industry improve its efficiency and operate in an environmentally responsible fashion. It is widely recognized that modern industrial economies have substantial energy needs. Most energy used in Illinois is produced from nonrenewable sources, including oil, coal, uranium and natural gas. Worldwide, about 88% of all purchased energy is derived from fossil fuels. (1) Each step in the extraction, processing, conversion, and transportation of these resources impacts our environment and results in the generation of waste.

Illinois is fortunate to have significant agricultural resources, with the production of ethanol from corn as one by-product. Ethanol-derived fuels rely on renewable resources compared with fossil fuels which are being depleted. But the chemicals and equipment used to produce crops rely on largely nonrenewable resources. A recent study indicated that the average energy gain in ethanol production is 34%. (10) This means that 34% more energy can be gained from the ethanol as a fuel than went into growing, harvesting and processing corn into ethanol. And, if best manufacturing practices were employed, a net energy gain of at least 93% could be realized.

A Sustainable Illinois will be one in which raw materials and energy are used more efficiently with less waste being produced. This may mean a greater reliance on renewable, clean energy resources. Further research will be needed on technologies to remove sulfur from coal, and on other ways of making coal a cleaner fuel. HWRIC needs to improve its understanding of the waste implications of new energy resources and the energy impacts of new technologies being used by industry. As part of HWRIC's P2 assistance efforts, we have seen the value of reducing not only wastes but also energy usage. Increasing the energy efficiency of manufacturing processes will reduce the rate of resource extraction, new power plant construction, and depletion of fossil fuels.

Both waste production and energy use must be considered when helping an industry improve its efficiency and operate in an environmentally responsible fashion.

E. Sustaining Growth Through Anticipation

Environmental management has historically been a response to identified pollution problems. Subsequent end-of-pipe attempts to reduce the amount of pollution entering the environment have been resource intensive. The effect of such control technologies has been to capture valuable resources wasted due to inefficiencies in the production process and, in the case of hazardous waste, to land dispose of these materials. Some of these residues have led to new environmental problems. Sustainable development requires that we examine more closely the raw materials lost in the production process and the longer term environmental consequences of the goods produced.

Sustainability seeks to preserve the quality of life for future generations. Encompassed in this concept are that the land will continue to be a productive source of food, that industry will continue to have the resources it needs to provide the goods and services required by society, that reasonably priced energy will continue to be available to all, and that we as a society will not destroy the air, water and land we depend upon for our well-being through contamination with our wastes.

In a recent report by USEPA and Industrial Economics, Inc., the authors state that achieving sustainable development in developed economies requires promoting “eco-efficiency.” (11) They define eco-efficiency as becoming more efficient, using less energy and material, producing less waste and pollution, and destroying less natural habitat per unit of economic growth. The authors state, “achieving eco-efficiency in U.S. industry will require companies to build strategic environmental protection into their business decisions.” They define strategic environmental protection as “long-term planning and investment by companies to develop the most cost-effective and innovative environmental management approaches, starting with pollution prevention.” USEPA is trying to promote these concepts through their Sustainable Industry Project, which has the primary goal of developing, testing and implementing industry-specific policy recommendations that will remove barriers to innovation and promote strategic environmental protection in the selected industries.

Since its inception, HWRIC has promoted a sustainable future in Illinois by encouraging industry to reduce its waste generation and better manage those wastes it does produce. This goal is best addressed through the incorporation of P2 concepts into the operations of modern industry. Pollution prevention, as practiced today, incorporates anticipation of the needs and problems of the future. New product life cycle analysis, for example, is prompting producers to look at the total costs and environmental implications of their products while still in the conceptual stage. Forward thinking businesses are beginning to capitalize on the advertising potential of “green” products or those that are totally recyclable.

HWRIC will continue to work with Illinois industry to increase awareness of the benefits of adopting pollution prevention in their production activities. But clearly the conversion to a Sustainable Illinois in all aspects of society must evolve from grass roots. The citizens of the state must embrace the concept, do their part, and express their desire to have society adhere to sustainability principals. Educational outreach offering sustainability concepts to all levels of society has become an imperative, not

a luxury. HWRIC can assist in the process by which children learn what is needed to ensure that their future retains access to the resources that we enjoy. We can help educate the professionals of tomorrow so that they take their place in society with an understanding of sustainable concepts as a requirement of their job, not as merely some alternative to the status quo. And we can continue to assist those in industry and agriculture to better understand the goals and concepts of sustainability, to recognize that sustainable products will open new markets in a worldwide sustainable economy, and to begin to work toward the adoption of sustainability principles in the workplace.

We must anticipate the future now. The road to a Sustainable Illinois is before us. State government must take the lead in choosing this road. It must envision the state as it will be left to future generations and take the necessary steps to insure that future is bright. Hopefully the Center's efforts toward a sustainable future will complement what other agencies and organizations are already doing in this regard and stimulate additional efforts throughout our society.

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Appendix B to HWRIC FY'94 Annual Report

*Seventh Annual
Governor's
Pollution Prevention
Awards*

Award and Certificate Winners



*Award Ceremony
September 22, 1993
The Executive Mansion
Springfield, Illinois*

Seventh Annual Governor's Pollution Prevention Awards

Trade Organization



*Chemical Industry Council of Illinois
Rosemont, IL*

The Chemical Industry Council of Illinois, a trade organization established to serve the needs of chemical manufacturers, promotes pollution prevention among its membership. A partner association in the Chemical Manufacturer's Association's Responsible Care Program, they conduct various pollution prevention activities throughout the state, including pollution prevention workshops and seminars for their members. They also compiled a press release on Toxic Release Inventory quantities of their member companies and noted the overall and media-specific reductions. CICI is organizing a state advisory panel to increase participation in Illinois EPA's Partners in Pollution Prevention Program.

Vendor



*Nalco Chemical Company
Naperville, IL*

Nalco Chemical Company is the world's largest producer of water, process, and wastewater treatment chemicals. Nalco has established a Water and Waste Minimization Department. The department's mission is to reduce the demand for fresh water and to minimize the discharge of wastewater from their own facilities as well as from their customer's plants. This department focuses on two areas: program development and project engineering, including process development and pilot field projects. To support this department, Nalco has developed mobile pilot plants, known as Advanced Recycling Centers (ARC), which are used for on-site demonstration of water conservation and recycling programs. ARCs contain unit operations for removing contaminants from water, pilot cooling towers, and complete analytical laboratories. Nalco's own water conservation and recycling program has saved over \$100,000 in water costs and \$25,000 in wastewater costs. The company has also assisted its customers in saving over \$1 million through similar water conservation and recycling programs initiated through use of the ARCs.



*Chicagoland Processing Corporation
Mt. Prospect, IL*

Chicagoland Processing Corporation (CPC) recycles photographic and X-ray film, recovering and refining the silver content and minting pure silver commemorative medallions. CPC has developed a new lumber substitute, known as Envirowood, made entirely of commingled plastic and plastic film generated from their scrap film recycling process. Envirowood can be used to manufacture reusable loading pallets, picnic tables, trash receptacles, decking, and fencing. Because of CPC's large-scale recycling capabilities, Envirowood loading pallets can be produced at a much cheaper price than other plastic pallets and can replace the traditional wood pallets, which are typically scrapped after six months of use. CPC is taking plastic waste from large manufacturers such as 3M and Ford Motor Co., recycling it, and selling it back in the form of Envirowood plastic pallets. CPC saves approximately \$120,000 per month by utilizing their own scrap plastic for Envirowood production rather than using virgin plastic or recycled plastic obtained from other sources.

Community Group



*Aurora Sanitary District
Oswego, IL*

The Aurora Sanitary District, a municipal wastewater treatment facility, has implemented a program to reduce their ammonia discharge into the Fox River. By modifying the operating schedules of certain processes, the ammonia load of the filtrate routed to wastewater treatment was equalized, rather than having high and low loads at different times of the day. The plant's subsequent biological treatment process handles the more constant ammonia load much better than the fluctuating amounts previously introduced to the system. This process modification required no capital investment and reduced the monthly average ammonia concentration discharged by 83%. The total ammonia discharged in 1992 was reduced by 86% (127,000 pounds) over the 1991 discharge. This improvement, along with several others made over the last 10 years, has been implemented without any increase in the residential user's fees.



*Central States Education Center
Champaign, IL*

The Central States Education Center is a community organization that focuses on natural resources and environmental issues. The Center has established a unique volunteer-implemented waste reduction program known as the Model Community Program. Model Community personnel train volunteers to help transform businesses, government institutions, and civic groups into models of waste reduction. To become a model, an organization must meet standards in four areas: waste prevention, elimination of toxins, purchase of recycled products, and recycling. The Center trains a steering committee to approach potential models in their community. If interested, the potential models recruit in-house committees. The Center has also developed a Training Manual for developing a Model Community Program and provides 15 training sessions throughout the year in participating communities. Currently, the program operates in eight Illinois communities and has identified more than 140 Model businesses, industries, and organizations that have reduced the volume and/or toxicity of their overall waste streams.

Educational Institution



University of Illinois at Urbana-Champaign Champaign, IL

The University of Illinois has established a comprehensive Recycling and Material Management Program at the Urbana-Champaign campus. This program is designed to conserve materials and energy by promoting waste reduction, reuse, and recycling. Various departments and student groups have identified and implemented reuse opportunities, such as reusing animal bedding for mushroom farming and collecting old telephone books for roofing material, hand towels, insulation, and animal bedding. The University also supports campus-wide recycling of paper, aluminum, plastic, glass, cardboard, scrap metal, wood, and other materials. All faculty, staff, and students can participate in this program. The University has also developed the nationally recognized Hazardous Waste Minimization and Recycling Program and is conducting a laboratory waste minimization survey to identify opportunities to reduce laboratory wastes.

Small Facility (1-150 employees)



Griffin Wheel Company West Chicago, IL

Griffin Wheel, a manufacturer of railroad brake shoes, has implemented the "Solvent Free Project" to reduce solvent waste and emissions associated with production of composition brake shoes. Previously, the solvent toluene was used to lower the viscosity of the resin for mixing and to soften the rubber in the binder matrix. To eliminate solvent use, Griffin worked with the supplier to reformulate the resin so solvents were unnecessary. A high shear mixer was purchased which uses mechanical force rather than chemical processes to mix the components of the matrix. Griffin eliminated the need for nearly 2 millions pounds of toluene per year. They also went from being DuPage County's largest single source of toluene air emissions (200,000 to 400,000 pounds emitted) to zero toluene emissions due to this change.



R.B. White, Inc. Bloomington, IL

R.B. White, a sheetmetal fabricator, uses an aqueous degreasing/phosphating process to remove oils from the metal and to apply a rust inhibitor prior to painting. They assisted in developing and installing an ultrafiltration system to remove emulsified oils from their phosphating/degreasing bath and to recover the phosphating and cleaning agents from the bath. Prior to the installation of the ultrafiltration system, this 5,000 gallon degreasing/phosphating bath was disposed of approximately every three months. Once the ultrafiltration system was operating, oils were continuously removed from the bath, thus generating only 250-300 gallons of waste per year. The phosphating and cleaning agents, for the most part, remained in the bath, reducing the requirement for new chemicals. R.B. White now saves approximately \$30,000 per year from reduced disposal and chemical costs.

Medium Facility (151-500 employees)



Harris Corporation, Broadcast Division Quincy, IL

Harris Corporation, a radio and television transmitter manufacturer, implemented several projects to reduce waste volume and toxicity and improve product quality. To eliminate the need for methyl chloroform (TCA, an ozone depleting compound) as a cleaning agent for hand-soldered printed circuit boards, Harris evaluated both no-clean and water-clean solders. Water-clean solders were found to be effective for their product line and were introduced into

the process. The results were a raw materials savings of \$4,500 per year and elimination of associated TCA disposal costs. A less toxic solvent, polane, was substituted for the methyl ethyl ketone (MEK) used as a paint reducer and cleaning solvent. Paint room employees also evaluated batch paint requirements, modified their mixing process to generate only the required amount, and thus reduced their paint waste by up to 75%, saving \$36,000 per year in disposal costs. By installing a gravity settler in their wastewater treatment system, Harris saved \$30,000 per year in sludge disposal and an additional \$8,000 per year in chemical consumption costs. Harris has also installed a solvent distillation unit to recycle the remaining solvents. Employee participation played a key role in the successful implementation of process changes at Harris.



G.E. Plastics Ottawa, IL

G.E. Plastics, a manufacturer of ABS thermoplastic resins, has established a Waste Minimization Team consisting of an employee representative from each of the seven major operating areas. Through the efforts of this team, G.E. Plastics implemented several projects to reduce waste. After years of experimentation, the process used to manufacture the ABS thermoplastic resin was modified. This reduced the amount of trace unreacted chemicals in the product and drastically

reduced emissions of volatile organic compounds by 90%, or more than 1 million pounds per year. G.E. also installed a separation system to break the waste water/organic compound emulsion resulting from the ABS manufacturing process. By reducing the waste volume sent off-site by 70%, G.E. realized an annual savings of over \$70,000. G.E. also modified the packaging of their product by reducing the number of containers and saving \$92,000 per year in packaging materials purchase. G.E. has also implemented a bulk storage/transfer system for chemicals that were previously purchased in drums, thus eliminating the disposal of over 700 drums per year.



Arens Controls, Inc. Evanston, IL

Arens Controls manufactures mechanical and electrical controls. Through their pollution prevention activities, Arens has realized an estimated cost savings of \$270,000 per year. They replaced their mineral spirits parts washing operation with an aqueous-based washing system equipped with an oil-water separator. This reduced their waste generation per month from 350 gallons of spent mineral spirits to less than 5 gallons of nonhazardous oil skimmed from the system, thus saving over \$9,000 per month in disposal and labor costs. To reduce the amount of cutting oil disposed of off-site, an oil filtering system was installed to prolong the life of the coolant, resulting in a reduction of 2,400 gallons and \$14,000 per year in disposal costs. Arens has also upgraded two water-cooled air compressors to air-cooled compressors and installed a recirculation system for cooling water, thus reducing the total water usage at the facility by 75%, or 9 million gallons. A solid waste trash compactor has also reduced the total volume of waste cutting costs by 66%.

Large Facility (> 500 employees)



Motorola, Inc. Schaumburg and Libertyville, IL

Motorola, Inc.'s Illinois facilities manufacture electronic products, including cellular telephones, two-way radios and base stations, ballasts for fluorescent lighting, parts for the automotive industry and personal paging systems. Motorola has a strong commitment to pollution prevention with emphasis on source reduction, reuse, and recycling. In 1989, Motorola made a corporate-wide commitment to eliminate the use of chlorofluorocarbons (CFCs) and other ozone depleting compounds by the end of 1992. These compounds were used primarily to clean printed circuit boards after soldering. Motorola has now implemented a no-clean soldering technology. Not only did this eliminate 100% of ozone depleting substances, but it also reduced production time and eliminated the CFC-based cleaning equipment which has since been decommissioned and scrapped. This resulted in a cost savings (from avoided solvent purchases) of over \$100,000 per year for the two Cellular Subscribers Group facilities that had been using CFCs. The solder system greatly reduces volatilization of solvents, thereby limiting volatile organic compound (VOC) emissions. Nitrogen hoods were also installed to reduce the oxidation of the solder, thus reducing the amount of lead-bearing solder waste.



Mobil Oil Corporation Joliet, IL

Mobil Oil's Joliet Refinery processes crude oil into premium petroleum products. The refinery has established a core team to coordinate, track, and ensure timely implementation of the pollution prevention program, projects, and procedures known as the Waste Minimization Committee (WMIN). This team has representatives from all departments at the facility. The facility has implemented a comprehensive program to track waste generated for off-site disposal and for wastes generated for recycle/reuse. This program includes color-coded dumpsters for various waste types. Monthly reports generated from this waste tracking program not only promote employee waste awareness but also provide specific focus areas for the WMIN committee. This program is being expanded to include waste management cost allocation to the specific waste generator. The WMIN team focused on residual oil and debris, the largest contributor to off-site landfill disposal. By training employees on source reduction and proper spill cleanup procedures, this waste stream was greatly reduced with a savings of over \$85,000 in disposal costs alone. A new vessel design also allowed Mobil to recycle oily solids generated from their wastewater treatment facility and thus save over \$500,000 in disposal costs. Source reduction techniques, such as review of operating procedures and process engineering modifications, were applied to spent caustic solids and spent caustic debris waste streams resulting in reduction of both. Mobil has also established a WMIN subcommittee to address general solid waste.



Tellabs Operations, Inc. Lisle, IL

Tellabs designs and manufactures voice, data, and digital telecommunications equipment. Since 1988, they have been working to reduce the CFCs used in their wave soldering operations. By implementing a no-clean flux process, they have reduced their 1992 CFC use by 78%, thus saving \$930,000 in material costs to date. They are also moving to a spray fluxing process to reduce raw material consumption and hazardous waste generation, expected to save nearly \$90,000 per year. Tellabs has also been practicing closed-loop recycling for their solder residue.

Appendix C: Research Project Summaries



A. Research Projects Continuing in FY'95

Toxic Heavy Metals in Biodegradation and Bioremediation Technologies *Eric Niederhoffer and John Koropchak, Southern Illinois University, Carbondale*

The Crab Orchard Natural Wildlife Refuge (CONWR) faces severe problems associated with contamination from a combination of toxic heavy metal ions (THM) and toxic organic compounds. It is necessary to gain a molecular-level understanding of how anaerobic microorganisms cope with THM, and whether they spread it, in order to understand how THM impact the biodegradation and bioremediation technologies used to clean up organic pollutants. The goal of the project is to develop THM-resistant microorganisms that are useful for THM pollution abatement, particularly for organic pollutants such as polychlorinated biphenyls (PCBs) and chlorofluorocarbons (CFCs).

The researchers propose to isolate THM-resistant mutants of extremely thermophilic (heat-loving) methanogens (bacteria that synthesize methane from hydrogen and carbon dioxide) and other selected anaerobic bacteria. They aim to further characterize the binding and uptake of THM to wildtype methanogens and to address the changes associated with THM-resistant methanogens, and to assess the effects of THM on the detoxification pathways common to methanogens and other selected anaerobic bacteria. Anaerobic consortia are typically comprised of a methanogenic component, which serves an instrumental role in the detoxification of organic wastes, acting in concert with other anaerobes.

The results will contribute to the development of more efficient strategies for biodegradation and bioremediation of mixed THM/organic contaminated sites and materials.

Air Sparging Investigation at Mattison Machine Works *Fehr-Graham & Associates, Freeport*

Air sparging (aerating water to clean it) is a recent technology which currently uses simple estimates instead of solid guidelines for establishing design criteria. Its success and its economic accessibility to smaller businesses, however, make it a technology that deserves further exploration. The goal of this research is to determine the quantitative relationships which can be used when designing an air sparging system. The effectiveness of air sparging at varying distances from the injection point and at differing depths of injection will be measured. At a minimum, the optimum design for a sparging system should be obtained for the Rock River alluvium and similar aquifers. The primary objective is to determine an empirical relationship that will allow remedial system designs to be optimized under a wide range of site conditions.

Development of an Activated Carbon Fiber Adsorption/Regeneration System to Recover and Reuse Toxic Organic Compounds

Mark J. Rood and Susan M. Larson, University of Illinois, Urbana-Champaign

Toxic chemical releases into the environment from facilities within Illinois have been estimated at 100×10^6 kilograms (kg) during 1990 (IEPA, 1992). Releases into



the atmosphere account for 38% of the toxic emissions. This research project will develop a new technology of activated carbon adsorption coupled with cryogenic (cold) vapor recovery that will reduce emissions and provide for reuse of toxic wastes.

Activated carbon fibers (ACF) will be studied in a laboratory-scaled packed bed configuration to measure breakthrough times of the bed for realistic gas stream conditions. The packed bed will be designed to optimize the bed life. Saturated ACF will be regenerated using a nitrogen carrier gas and electrical resistance heating. The nitrogen gas stream containing the concentrated toxic gas will then be treated cryogenically with liquid nitrogen. Cryogenic treatment of the gas stream will condense the toxic materials from its carrier gas, making the toxic material available for reuse in the original process.

This research will be performed in collaboration with Liquid Carbonic, Inc., an Illinois-based company that developed and manufactures the cryogenic air quality control device. Collaboration with Liquid Carbonic will allow for a better overall design of the system, a more rapid distribution of this innovative technology into the industrial market, an exchange of information between the University of Illinois and industry, and a broadening of adsorption and cryogenic applications.

Field Testing of *In Situ* Phosphatizing Coatings

Chiu-Tsu Lin, Northern Illinois University, DeKalb

The goal of this project is to develop an environmentally and economically sound "clear" and "pigmented" single-step phosphate/paint system (PPS) that will provide superior protection for metal surfaces. This has been achieved during the first year of the project. During this funding period, the field testing of coating

protective performance for the newly formulated *in situ* phosphatizing coatings will take place.

Standard American Society for Testing and Materials (ASTM) adhesion and corrosion tests will be performed to provide an acceptable single-step PPS from an application perspective. The surface bonding nature of the corrosion protective barrier of the *in situ* coating will also be examined. The combination of the phosphate, primer, and topcoat into a single-step application process will offer significant reduction in time, energy, material, and labor. More importantly, the uniconat PPS will eliminate the wash primer or pretreatment step and its associated wastestreams which contain hexavalent chromium. The single step process will also reduce volatile organic compounds in the formulation. Progress to date includes verification of the chemical principle of *in situ* phosphatized coatings; isolation of several effective *in situ* reagents; formulation of a single-step, air-dried PPS; and an analysis of the protective performance of these coatings.

Enhancement of BTEX Biodegradation Rates Under Iron-Reducing Conditions

Walton R. Kelly and Michael L. Machesky, Illinois State Water Survey, Champaign

Some of the most common organic pollutants found in groundwater are the monoaromatic hydrocarbons, such as benzene, toluene, ethylbenzene, and xylene (BTEX). Because these compounds are biodegradable under a variety of environmental conditions, *in situ* bioreclamation is a viable strategy for cleaning contaminated aquifers. BTEX are known to rapidly biodegrade under aerobic (oxygen-rich) conditions. Unfortunately, oxygen is almost always absent in aquifers contaminated with significant amounts of these compounds. This study proposes to examine the value of stimulating iron-reducing bacteria in such anaerobic environments to biodegrade BTEX.

Experimental results conducted on samples from a contaminated aquifer will provide information on biodegradation reaction processes and rates, indicating whether attempts to enhance these reaction rates in situ is a worthwhile endeavor.

Product and Process Design Tradeoffs for Pollution Prevention

Deborah L. Thurston, University of Illinois, Urbana-Champaign

Like design for manufacturability, design for the environment poses special problems. It was once considered outside the designer's domain. No analytical tools exist to integrate these issues into conventional engineering design analysis. Unavoidable tradeoffs must often be made between cost, performance, manufacturability, and customer satisfaction. Decisions must be made under a great deal of uncertainty and with input from multiple sources. The current trend in environmental protection legislation shifts the financial responsibility for environmental mitigation of industrial impact to the industry carrying out the activity. Traditional manufacturing cost analyses do not reflect this total, long-term cost. This project integrates design evaluation and optimization and life cycle analyses into a comprehensive design process.

The cost of environmental impacts will be incorporated into the concurrent multi-objective analysis in two ways: 1) statistical manufacturing process control which treats pollution as a product defect; and, 2) the cost of compliance with regulations. The "internalization of externalities" will be analyzed with the same degree of mathematical rigor that engineers traditionally utilize only for models of physical systems.

Starlings as Avian Models and Monitors of Remedial Effects at Crab Orchard National Wildlife Refuge

Richard S. Halbrook and Alan Woolf, Southern Illinois University, Carbondale

The 1988 Remedial Investigation of Crab Orchard National Wildlife Refuge (CONWR) identified 7 contaminated areas within the refuge that posed a potential risk to wildlife and recommended remediation of these sites. Exposure and effects data for avian (bird) species in these areas are limited. Preliminary studies revealed significant accumulations of contaminants and harmful effects in starlings nesting at one of the identified sites. The project goal is to determine pre-remediation base-line exposure and effects data on an avian model (the starling) and to provide a benchmark for assessing the effectiveness of remediation. The end result will be to provide regulatory authorities with exposure and effects data for avian species utilizing contaminated sites at CONWR and to provide pre-remediation base-line measurements that can serve as a benchmark for documenting the effectiveness of remedial action.

Impact of Fly Ash Disposal on Plant Development

A. Lane Rayburn, University of Illinois, Urbana-Champaign

The purpose of this project is to determine the effect of fly ash disposal on plant development; corn seedlings are being used for this study. As utilities continue to burn coal to produce electricity, vast amounts of fly ash are being produced as a waste byproduct. Studies have indicated that use of fly ash in strip mine reclamation and agriculture land amendment would help alleviate problems associated with landfill disposal of fly ash; however, little information exists regarding the long-term subtle effects that such uses could produce. Long term exposure to levels of toxic chemicals (like those in fly ash) too low to induce toxicity may have





subtle effects on the genetic material contained within the plant nucleus. Alterations in the plant nucleus have been documented in growth experiments using coal fly ash mixed with soil at rates of 70 tons/hectare and 500 tons/hectare. These higher concentrations of fly ash disrupted the cell cycle of seedlings and produced some triploid plants. Despite the nuclear alterations, plants grown at 70 tons/hectare of fly ash appeared healthy. Long-term growth studies are underway.

Identifying Site Specific Limitations to Successful *In Situ* Bioremediation of Agrichemical Retail Sites

Michael A. Cole, University of Illinois, Urbana-Champaign

The purpose of this project is to develop a battery of tests to identify site-specific limitations to bioremediation at several Illinois pesticide-contaminated agrichemical sites. The results will be a protocol for others to use to identify limitations at other sites. The test will define the physical, chemical, and biological properties of the contaminated sites and compare them with the properties of adjacent uncontaminated areas. Site variability will also be evaluated with respect to these properties. Results thus far demonstrate that pesticide-contaminated soils can be remediated on a greenhouse scale by relatively simple methods. Nutrient and compost amendments have been shown to be reasonably effective in reducing pesticide concentrations.

Effect of Chemical Immersion on Interface Strengths of Hazardous Waste Landfill Liner Systems

Timothy Stark, University of Illinois, Urbana-Champaign

Landfills still receive the majority of the hazardous and solid waste generated in Illinois and will probably continue to do so for many years. As a result, new landfills must be sited and built to accommodate new waste, and old landfills need to be covered.

Recognizing that leachates from industrial and municipal solid wastes may be as damaging as those from hazardous wastes, the USEPA proposed Subtitle D regulations that recommend the use of soil-geosynthetic liner systems for solid waste landfills. The integrity of these liners can be compromised by physical and chemical factors. This study will test the effect of chemical immersion on the peak and residual strengths of both soil-geosynthetic and geosynthetic-geosynthetic liners.

Progress to date includes completion of torsion ring shear tests on textured high density polyethylene (HDPE) geomembrane/non-woven textile, geocomposite, and cohesive soil interfaces. Results indicate that a separation layer should be used to prevent strength loss in the liner at interfaces. Also, the type of clay used for the compacted clay liner significantly effects the interface strength. Increasing the plasticity of the clay increases the interface strength.

Waste Management Survey of Illinois Higher Education Institutions

Diane O'Rourke, University of Illinois, Chicago

The objective of this project is to conduct a survey of waste management policies and practices of Illinois institutions of higher education. Participants will be asked to respond to questions regarding the personnel responsible for solid/hazardous/other waste management on each campus, and the structure under which those persons perform their duties. In addition, the survey will gather detailed information about the institutions, their waste management programs and generation sources, and their need for assistance.

Technology Transfer to Aid Pollution Prevention and Waste Management

Vicki Gwasda, University of Illinois, Chicago

A survey of manufacturing firms in Illinois will be conducted to determine their assessment of technologies needed to meet new regulations and achieve source reduction. Information about the successful application of waste reduction technologies in Illinois will be gathered. The survey results will assist HWRIC in the selection of possible technology alternatives offered to companies and in the production of written materials describing proven pollution prevention alternatives.

Overcoming Barriers to Pollution Prevention in Small and Mid-Size Illinois Manufacturers

Thomas J. Bierma, Illinois State University, Normal

This project is working toward two basic goals— a survey evaluating the usefulness of HWRIC's *Pollution Prevention: A Guide to Program Implementation* manual (report TR-009), and investigating methods to overcome barriers to accepting and implementing pollution prevention programs. Assistance in the manual evaluation will be obtained from companies who have used the document for pollution prevention program development within their companies as well as those who have not. The researchers hope to identify avenues that HWRIC can use to better market our pollution prevention services, as well as to provide a marketing model for other states' pollution prevention technical assistance programs to adopt.

Determination of Animal Hazards from Air and Soil Samples from Crab Orchard

Larry Hansen, University of Illinois, Urbana-Champaign

This project uses bioassay methods for hazard identification, hazard characterization and dose-response assessment of various matrices associated with the PCB-laden landfill in Crab Orchard National Wildlife Refuge. The site is on the Superfund National Priorities List. Soil, dust, and air samples have been analyzed for PCB congener composition. Landfill extracts containing contaminants are being used for dosing laboratory rats to determine morphological (acute) toxicity, neurotoxicity, and reproductive and developmental effects. The project will provide an animal hazard ranking, based on multiple biological endpoints, resulting from exposure to samples known to be contaminated with polychlorinated biphenyls (PCBs).

Household Pets as Sentinels of Lead Exposure Phase II: A Study of Lead Exposure

William Buck, University of Illinois, Urbana-Champaign

Phase I of this study was conducted to determine the health effects of lead-contaminated soils in dogs, cats and children residing near a secondary lead smelter. The sample sizes were 84 dogs and 26 cats in 80 households with a total of 198 humans. Animals living outside, exposed to soil, were more at risk of having a high blood lead concentration (BLC) than pets living inside. The strongest correlation between children and pets sharing the same household was between younger children (up to 6 years of age) and indoor animals.

The likelihood of finding someone in the household with a high BLC was significantly increased when a pet was found to have a high BLC. However, the range of BLC was fairly small compared to those





found in previous studies (<5 to $28 \mu\text{g}/\text{dl}$ (micrograms per deciliter) in pets, and 1 to $13 \mu\text{g}/\text{dl}$ in humans). Thus, the overall risk from lead contamination in this study appeared limited. The most significant changes in blood or serum biomarkers in either dogs or cats was reduced delta-aminolevulinic acid dehydratase activity (ALAD), while free erythrocyte protoporphyrin was increased only when BLC was above $20 \mu\text{g}/\text{dl}$.

These conclusions follow from the data.

1) Dogs and cats in the household are more at risk than their owners of having high BLC when exposed to a similar environment. 2) Soil lead concentrations should not be the major parameter used to estimate the risk of increased lead exposure to humans or their pets, since many other factors influence the bioavailability of lead, e.g., soil characteristics (pH and cation exchange capacity), lead particle size and chemical form, lifestyles of both animals and humans. 3) Monitoring dogs and cats would be a cost-effective way to predict risks to humans, if any, associated with a lead-contaminated environment.

Phase II of this project will examine the effect of native soil cation exchange capacity (CEC) and pH on the availability of lead to rats from both in situ contaminated and lead acetate-dosed soils. The project objectives include determining: 1) the pH, soil types, and CEC of residential soils around the lead contaminated site; 2) the bioavailability of lead in these soils to laboratory rats; 3) whether raising the pH will reduce the bioavailability of lead in the soils; and 4) if extractable lead in soil is correlated with availability of lead to rats.

B. Research Projects Completed in FY'94

Development of an Environmentally Safe Conversion Coating System for Magnesium

Owen M. Briles, Sundstrand Aerospace, Rockford

Magnesium alloys are essential for aerospace applications because of their high strength to weight ratio. Conversion coatings are applied to these alloys to provide atmospheric corrosion protection and to improve adherence characteristics of coatings. Processes used to produce these coatings typically involve the use of halogenated solvents, chromic acid and other substances that can be toxic to humans and the environment. Chromated magnesium is typically protected from in-process corrosion by application of preservative oils, which must be removed by solvents prior to final coating applications.

This project included replacing halogenated solvents with an aqueous degreasing system, replacing chromic acid cleaning with chromium-free cleaners, substituting phosphate-fluoride chemistry for chromates in conversion coating, and applying a resin seal-coat to prevent in-process corrosion. Implementation of the new system will result in a final cost-savings of at least \$28,000. A factsheet on this project should be available in early 1995.

Pollution Prevention for Chemical Processes: A Handbook with Solved Problems from the Refining and Chemical Processing Industries

David T. Allen and Kirsten S. Rosselot, University of California, Los Angeles, CA

The refining and chemical process industries are responsible for nearly half of the releases and transfers reported in the Toxic Chemical Release Inventory in the state of Illinois. The handbook is designed for use in short courses, training sessions, and as a supplementary text in university-based

engineering design courses.

The handbook is divided into four sections covering: basic pollution prevention structures; reduction of volume/toxicity of wastestreams; cost assessment of current disposal practices; and case studies. Questions and problems for both, non-technically trained personnel and for engineering design students are provided, along with possible solutions. It is available from the HWRIC Clearinghouse and can be obtained by requesting report TR-022.

An Investigation of Column Flotation Technologies for the Pretreatment and Volume Reduction of Contaminated Soils and Sediments

Joseph FitzPatrick, Northwestern University, Chicago

Soils may be contaminated by improper waste disposal, leaking underground storage tanks, accidental chemical releases, and runoff from industrial, agricultural, or disposal areas. Treatment technologies for contaminated soils and sediments include stabilization, vapor extraction, bioremediation, solvent extraction, soil washing, and vitrification. Remediation processes are often integrated to achieve effective treatment. This adds to the time, effort, and cost of remediation. This project is investigating a column flotation technology that would separate the fine fractions of low to moderately-contaminated soils and sediments from cleaner ones, effectively reducing the volume of soil requiring further treatment. The use of flotation technology in soil and sediment remediation is relatively new, and by and large, empirical.

Phase one of this research: 1) examined the separation behavior of a model sediment system using flotation screening tests; 2) determined the effects of particle size, contaminant hydrophobicity and concentration, gas velocity and residence time; and 3) developed a correlation to predict separation behavior in a system using

contaminated sediments. Phase two examined actual sediment and soil cleaning to verify the battery limits of the cleaning process. Phase three developed a means to evaluate the effectiveness and economic feasibility of using column flotation in remediation.

LUST Remediation Technologies: Options for Groundwater Corrective Actions

Perino Technical Services, Springfield

This investigation identified the basic free product recovery and groundwater cleanup strategies that are currently being accepted by the IEPA. The groundwater remediation technologies include: conventional "pump-and-treat" bioremediation, and aquifer aeration (also known as aquifer air sparging), *in situ* bioremediation, vacuum vaporization, and recovery of liquid petroleum hydrocarbons. Information has been gathered on the characteristics of each technology, data required for design of cleanup systems, effectiveness and suitability of various soil types and contaminants, and cost, where available. The final report includes a section discussing regulatory and permitting requirements that are applicable to groundwater cleanups in general and to individual cleanup technologies. The project final report is now available and can be obtained by requesting report TR-023 from the HWRIC Clearinghouse.

Treatment of Spent Chemical Oxygen Demand Solutions for Safe Disposal

Thomas R. Holm, Illinois State Water Survey, Champaign

Analysis for chemical oxygen demand (COD) is routinely performed at wastewater treatment operations. This research project developed a method for treating spent COD solutions which contain toxic metals. As a result of this treatment, concentrations of Mercury and Chromium will be reduced by at least 99%, which will greatly reduce the loadings of Mercury and





Chromium from laboratories performing COD determinations. The method will be rapid and convenient.

Stabilization of Arsenic Nonwastewaters
Robert Fuessle and Max Taylor, Bradley University, Peoria

In 1984 the Hazardous and Solid Waste Amendments to RCRA were signed into law requiring USEPA to promulgate regulations for treating hazardous wastes before land disposal. USEPA has declared vitrification (using heat and pressure to solidify wastes) the best demonstrated available technology (BDAT) for arsenic-containing wastes because it effectively treats a variety of these wastes. Given the limitations of vitrification, i.e., it is energy intensive and creates potential air quality concerns, stabilization may be a desirable alternative treatment for arsenic wastes. The goal of this research was to develop a stabilization process that would treat arsenic nonwastewaters in a cost-effective and volume-efficient manner.

Investigators studied arsenic speciation in waste, a mix and design matrix with a stabilizing agent, and deterioration of the stabilized cement product. Arsenic in an actual D004/D005 (regulatory category) waste was stabilized for 540 days. Various stabilization designs were used to define a range of designs that are effective over the long term for a wide range of binder and waste compositions. The effectiveness of stabilization designs was determined primarily by the Toxicity Characteristic Leaching Procedure (TCLP). Dynamic column leaching, scanning electron microscopy, and calorimetry were also performed and reinforced conclusions. Data analyses included mass balance and correlation studies among the metal concentrations that permit a characterization of elements leaching from the binders and/or waste.

Ferrous sulfate was the preferred stabilization reagent over ferric sulfate and aluminum sulfate.

Excessive sulfate appeared to slow cement hydration with possible deleterious effects over the long term. Arsenate stabilization was more easily accomplished compared to arsenite. Aeration and/or chemical oxidation may be used to oxidize arsenite to arsenate for improved stabilization. The report is now available through the HWRIC Clearinghouse as report RR-073.

Course in Pollution Prevention
Paul Anderson, Illinois Institute of Technology (IIT), Chicago

A pollution prevention course was developed and offered in Spring 1994 at IIT to students in metallurgical, electrical, civil, chemical, mechanical and environmental engineering. Course contents included examining waste management options, developing a pollution prevention program, methods to conduct detailed assessments, ranking pollution prevention options, risk assessment, economic analysis, life cycle assessment as well as technical presentations on specific waste management options. Students conducted an in-depth study of a particular industry-type, looking specifically for pollution prevention options for that industry. Course notes and presentation materials will be available in early 1995.

Development and Pilot Demonstration of a Computerized Barcode-Based Waste Tracking System for Waste Minimization at Argonne National Laboratory
Robert Peters, Argonne National Laboratory, Argonne

This project combined the use of process waste assessments with a barcode-based waste tracking system. It identifies significant areas for waste reduction at Argonne National Laboratory (ANL). The development and implementation of a computerized barcode waste tracking system will enable ANL to track their hazardous wastes and will facilitate the waste chain-of-custody from the point of generation to ultimate disposal. ANL's Energy Systems Division has been selected for a pilot

demonstration of the system. The report detailing the effectiveness of the system is anticipated in spring 1995.

Pollution Prevention and Business Management: Curricula for Schools of Business and Public Health

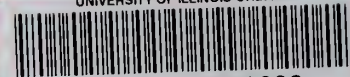
Thomas J. Bierma, Illinois State University, Normal

Three instructional modules on pollution prevention have been developed to supplement course material in schools of business and management, schools of public health with an emphasis in management and the environment, and schools of environmental studies with an emphasis in management. The modules are designed to be flexible, and may be used together or independently. Although intended to be read outside of class, then discussed in class, the modules offer many opportunities for outside and in-class activities, additional reading and research, and supplemental lectures. More importantly, the modules are intended for participatory learning. The problems and case studies which accompany each module are an integral part of the learning process, particularly if discussed in groups or in class as a whole. The modules will be available for distribution in early 1995.

An Analysis of Municipal Solid Waste Reduction Opportunities in Industrial/Commercial Distribution Networks
Matthew Snyder, Community Recycling Center, Inc., Champaign

The objective of this study was to develop a program for reducing, reusing, and recycling waste from industrial packaging and transport in the manufacturing/distribution/retail chain. The study focussed on the distribution network for consumer products, primarily food and grocery distribution. It described a pilot program for reducing, reusing, and recycling waste at a distribution facility. A complete report will be available in spring 1995.





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